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SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
Bulletin 71

# A MONOGRAPH OF THE FORAMINIFERA OF THE NORTH PACIFIC OCEAN

PART III. LAGENIDÆ

BY

JOSEPH AUGUSTINE CUSHMAN
*Of the Boston Society of Natural History*

WASHINGTON
GOVERNMENT PRINTING OFFICE
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II

# INTRODUCTION.

The present volume is the third of a series dealing with the Foraminifera of the North Pacific Ocean. It contains the Foraminifera included in the family Lagenidæ. The first part, issued in 1910, included the families Astrorhizidæ and Lituolidæ. The second part, issued in 1911, included the family Textulariidæ. The fourth part will be devoted to the Chilostomellidæ, Globigerinidæ and Nummulitidæ, and further volumes will take up the remaining families of the Foraminifera as they are represented in the North Pacific.

JOSEPH AUGUSTINE CUSHMAN.

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# A MONOGRAPH OF THE FORAMINIFERA OF THE NORTH PACIFIC OCEAN.

## LAGENIDÆ.

By Joseph Augustine Cushman,
*Of the Boston Society of Natural History.*

### INTRODUCTION.

This third part of the work on the North Pacific Foraminifera deals entirely with the Lagenidæ, a family following in natural sequence those families already considered in the two earlier parts. The same arrangement of data is here adopted.

The treatment of the Lagenidæ will be found perhaps more conservative than that adopted in the earlier parts. This is due mainly to the much greater amount of work that has been done on this family by students of the Foraminifera. The Lagenidæ have seemingly always been a favorite with workers on the group, and the amount of literature is far greater than that on the families thus far considered.

There have been a number of works treating of the genus *Lagena* alone, and it has therefore been unnecessary to describe any great number of new species. The recent publication of Mr. Sidebottom on *Lagena*[1] has been of great assistance.

With the working out of the distribution of various species the faunal areas of the North Pacific have become more clearly defined. The number of species found at some stations of the United States Bureau of Fisheries steamer *Albatross*, off southern Japan, which are recorded by Brady from off the Philippines, is very considerable.

In addition to determining restrictions of range it has been possible to greatly extend the known range of certain species.

In this part, in addition to the data given in the other parts, the bottom temperature record of the station has been given in many cases. With certain species this seems to have a definite bearing on the distribution.

[1] Journ. Quekett Micr. Club, vol. 11, 1912.

A systematic presentation of the various groups of the family follows:

## Family 5. LAGENIDÆ.

Test calcareous, vitreous, finely perforate; either monothalamous or made up of a series of chambers arranged in a straight or curved axis, or close coiled or spirally, or even in an alternating manner; aperture either radiate or simple, with a neck and phialine lip.

The Lagenidæ form one of the most distinctive groups of the Foraminifera and its members are readily recognized. Usually the genus *Lagena*, making up the subfamily Lagenidæ, has been taken as the radicle from which the other genera have been derived. Species like *L. globosa* probably come as near a primitive radicle for this family as it is possible to determine.

From *Lagena* the simplest step in development is a series of such chambers as is seen in *Nodosaria*. On the other hand this series may become coiled as in *Cristellaria*. With these two genera as the base all the genera of the subfamily Nodosariinæ may be definitely assigned to one or the other groups. With *Nodosaria* belong such genera as *Lingulina* and *Triplasia* and with *Cristellaria* as reversionary forms, *Marginulina*, *Vaginulina*, and *Frondicularia*.

With the subfamily Polymorphininæ a distinct mode of development is instituted, an alternating subspiral arrangement being introduced, usually accompanied by a radiate type of aperture.

In the subfamily Uvigerininæ there is again a spiral arrangement, much more definite in its characters and the aperture typically has a long neck and phialine lip.

In the subfamily Ramulininæ the method of growth is very irregular and a mass of stolon-like tubes results.

In various genera microspheric and megalospheric forms occur and as usual the microspheric form holds longest to the earlier developmental stages. These stages tend to show that many of the genera have been derived from a coiled ancestral type, although in the megalospheric form this is not so definitely shown.

The Lagenidæ are richly ornamented and the range includes costæ, spines, wing-like plates as well as complicated surface patterns, especially well developed in the genus *Lagena*. The various combinations of surface ornamentation, together with the delicacy of form and curves that appear throughout the group make the Lagenidæ by far the most interesting of the various groups of the Foraminifera.

Although some forms are found in shallow water, the best development of the Lagenidæ takes place in waters from 50 to 500 fathoms in depth. *Lagena* is found in perhaps greater numbers between 1,000 and 2,000 fathoms as far as the North Pacific material shows. Warmer waters are necessary for the best development of *Cristellaria*, *Nodosaria*, etc.

### Subfamily 1. LAGENINÆ.

Test consisting of a single chamber, the aperture either ecto- or entosolenian.

This subfamily includes the single genus *Lagena*.

### Genus LAGENA Walker and Boys, 1784.

*Lagena* Walker and Boys (type, *L. globosa* (Montagu)), Test. Min., 1784, p. 3.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 440.

*Description.*—Test monothalamous, smooth or ornamented, generally flask-shaped, aperture ecto- or entosolenian.

The genus *Lagena* is one of the largest in point of view of numbers of described species and varieties of any of the genera of the Foraminifera. The opinion as to the limits of variation in the group varies with nearly every student of the group. In the material I have examined I have again and again been made aware of the similarity, even the almost identical character of ornamentation in specimens from widely separated stations, but usually in the same faunal area. Then, too, there must be recognized a considerable amount of variation in the group as well. The whole problem of *Lagena* is a very puzzling one, but the greater the amount of material from a given area the more definite these limits of variation seem. With a large series of specimens from a given faunal area it would seem that the limits of variation might be rather definitely fixed and a more orderly system brought out of the present somewhat chaotic condition.

In describing the various species and varieties of *Lagena* a general scheme has been adopted of keeping those species together which have similarities of ornamentation. In this way they may be most easily grouped, and this has been the method usually followed by previous writers.

On the basis of the aperture various names have been used in a generic sense, such as *Entosolenia*, *Fissurina*, *Phialina*, and so on, and on the basis of form many others have been used. The value of these groupings can only be tested by the study of large series as has already been suggested.

I have not tried to make the synonymy in any sense complete, as the whole literature in regard to the genus is in such a chaotic state. The following species and varieties have been recognized from the North Pacific:

#### LAGENA GLOBOSA (Montagu).

Plate 4, fig. 2.

"Serpula (Lagena) laevis globosa" Walker and Boys, Test. Min., 1784, p. 3, pl. 1, fig. 8.

*Vermiculum globosum* Montagu, Test. Brit., 1803, p. 523.

*Lagena globosa* Brown, Illus. Rec. Conch. Great Britain and Ireland, ed. 1, 1827, pl. 1, fig. 37; ed. 2, 1884, p. 126, pl. 56, fig. 37.—Reuss, Sitz. kais. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 318, pl. 1, figs. 1–3; Bull.

Acad. Roy. Belg., ser. 2, vol. 15, 1853, p. 143, pl. 1, figs. 13, 14.—Jones, Parker, and H. B. Brady, Pal. Soc. Mon., vol. 19, 1866, p. 32, pl. 1, fig. 32.—Butschli, in Bronn, Klassen und Ordnungen Thier-Reichs, vol. 1, 1880, p. 197, pl. 7, fig. 2.—Terquem, Mém. Soc. Géol. France, ser. 3, vol. 2, 1882, p. 26, pl. 1, fig. 7.—Terrigi, Atti Accad. Pont. Nuovi Lincei, vol. 35, 1883, p. 170, pl. 2, fig. 3.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 452, pl. 56, figs. 1–3.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28 (Sci.), 1885, p. 336.—Sherborn and Chapman, Journ. Roy. Micr. Soc., 1886, p. 744, pl. 14, fig. 11.—Haeusler, Neues Jahrb. für Min., 1887, pt. 1, p. 181, pl. 4, figs. 1–4 (not 5–18).—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 221.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 477.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 323, pl. 10, fig. 69.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 77, pl. 13, fig. 741.—Chapman, Proc. Zool. Soc. London, 1895, p. 27.—Morton, Proc. Portland Soc. Nat. Hist., vol. 2, pt. 4, 1897, p. 116, pl. 1, fig. 1.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, 1899, p. 102, pl. 5, fig. 3.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 306, pl. 53, fig. 4.—Kiaer, Rep. Norwegian Fish. Mar. Invest., vol. 1, No. 7, 1900, p. 39, pl., fig. 17.—Millett, Journ. Roy. Micr. Soc., 1901, p. 3.—Rhumbler, Zool. Jahrb. Abth. Syst., vol. 24, 1906, p. 63.—Sidebottom, Mem. Proc. Manchester Lit. and Philos. Soc., vol. 50, No. 5, 1906, p. 1.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 141.—Sidebottom, Mem. Proc. Manchester Lit. and Philos. Soc., vol. 54, No. 16, 1910, p. 14.

*Entosolenia globosa* Williamson, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 16, pl. 2, figs. 13, 14; Rec. Foram. Great Britain, 1858, p. 8, pl. 1, figs. 15, 16.—Dawson, Can. Nat., vol. 4, 1859, p. 28, figs. 4, 5; vol. 6, 1872, p. 254, pl. 3, fig. 2.

*Lagena sulcata*, var. (*Entosolenia*) *globosa* Parker and Jones, Philos. Trans., vol. 155, 1865, p. 348, pl. 13, figs, 37*a*, *b*; pl. 16, figs. 10*a*, *b*.

*Description.*—Test subspherical, smooth, aperture either stellate or a fissure with an entosolenian neck, wall thin, usually transparent, but sometimes thicker and nearly opaque, white.

Length about 0.35 mm.; breadth usually a little less.

*Distribution.*—This species seems to be a cosmopolitan one and is well distributed in the North Pacific as elsewhere. Nearly all the stations are in deep water, but a few are in shallow depths and near shore in the case of the record of Rhumbler off the Chatham Islands and Brady from the coral reefs of Honolulu.

A great many very variable figures are found if one looks up the synonymy of this species. According as the author's idea of variation has been restricted or loose the number of things put here varies. Perhaps the worst example of the latter is that of Parker and Jones.[1]

[1] Ann. Mag. Nat. Hist., ser. 2, vol. 19, 1857, pl. 11, figs. 25–29, where four figures referred to this species are four distinct species not one of which can be in any sense truly referred to this species with a smooth test. Brady's specimen from the Silurian as figured might be fully as well and perhaps better some form of *Difflugia* than *Lagena globosa*.

Balkwill and Wright, 1885, make note of two forms occurring in their material, one with a stellate aperture the other with a fissure. With a large collection of material various forms would doubtless be found which are perhaps of varietal rank and definitely distributed.

LAGENA OVUM (Ehrenberg).

Plate 2, fig. 2.

*Miliola ovum* EHRENBERG, Berlin Monatsber., 1843, p. 166; Mikrogeologie, 1854, pl. 23, fig. 2; pl. 29, fig. 45; pl. 31, fig. 4.

*Lagena ovum* MARSSON, Mitth. nat. Ver. Neu-Vorpom. Rügen, Jahrg. 10, 1878, p. 120, pl. 1, fig. 1.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 454, pl. 56, fig. 5.

*Description.*—Test elongate, elliptical in front view, nearly circular in cross section, slightly compressed, ends broadly rounded, nearly equal; wall thin, transparent, smooth; aperture broadly elliptical, central, with a comparatively short entosolenian neck.

Length 0.4 mm.; breadth 0.2 mm.

*Distribution.*—Brady records this species from a single *Challenger* station in the North Pacific, in 2,300 fathoms. Specimens apparently referable to this species have occurred at three *Nero* stations, 1129 in 1,505 fathoms between Guam and Yokohama, 2049 in 2,226 fathoms, and 2064 in 1,355 fathoms, both off the Hawaiian Islands.

Ehrenberg's figures referred to *Miliola* are rather crude and indeterminate to which to assign this recent species, and it may be questioned whether this is a wholly satisfactory disposal of these almost elliptical forms.

LAGENA LÆVIS (Montagu).

Plate 1, fig. 3; plate 38, fig. 5.

"Serpula (Lagena) lævis ovalis" WALKER and BOYS, Test. Min., 1784, p. 3, pl. 1, fig. 9.

*Vermiculum læve* MONTAGU, Test. Brit., 1803, p. 524.

*Lagenula lævis* FLEMING, Brit. Anim., 1828, p. 235.

*Lagena lævis* WILLIAMSON, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 12, pl. 1, figs. 1, 2.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 455.—JONES, Quart. Journ. Geol. Soc., vol. 40, 1884, p. 769, pl. 34, fig. 3 [?].—SHERBORN and CHAPMAN, Journ. Roy. Micr. Soc., 1886, p. 744, pl. 14, fig. 13.—HAEUSLER, Neues Jahrb. für Min., pt. 1, 1887, p. 181, pl. 4, figs. 31–49.—FORNASINI, Mem. Accad. Sci. Ist. Bologna, ser. 4, vol. 10, 1890, p. 466, pl. 1, fig. 1.—MARIANI, Boll. Soc. Geol. Ital., vol. 10, 1891, p. 725, pl. 21, fig. 9.—WRIGHT, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 478.—FORNASINI, Mem. Accad. Sci. Ist. Bologna, ser. 5, vol. 3, 1893, p. 431, pl. 2, fig. 1.—CHAPMAN, Journ. Roy. Micr. Soc., 1893, p. 581, pl. 8, fig. 5.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 74, pl. 13, figs. 719–722.—EGGER, Jahrb. 16, Nat. Ver. Passau, 1895, p. 24, pl. 2, fig. 11.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 51.—FORNASINI, Mem. Accad. Sci. Ist. Bologna, ser. 5, vol. 7, 1898, p. 210, pl., fig. 19.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, 1899, p. 102, pl. 5, fig. 2.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 306, pl. 53, fig. 6.—WRIGHT, in Meade, Geol. Mag., dec. 4, vol. 7, 1900, p. 100, pl. 5, fig. 12.—SILVESTRI, Mem. Pont. Accad. Nuovi Lincei, vol. 17, 1900, p. 244, pl. 6, fig. 56.—MILLETT, Journ. Roy. Micr. Soc., 1901, p. 9.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 141.

*Miliola lævis* EHRENBERG, Mikrogeologie, 1854, pl. 26, fig. 2; pl. 31, fig. 5.

*Ovulina clava* EHRENBERG, Mikrogeologie, 1854, pl. 32, II, fig. 2*b*.

*Lagena vulgaris* WILLIAMSON, Rec. For. Great Britain, 1858, p. 4, pl. 1, figs. 5, 5*a*.—REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862, p. 321, pl. 1, fig, 15; pl. 2, figs. 16, 17.

*Lagena sulcata*, var. *lævis* PARKER and JONES, Philos. Trans., vol. 155, 1865, p. 349, pl. 13, fig. 22; pl. 16, fig. 9*a*.

*Description.*—Test in front view oval, elliptical, or nearly circular, with a more or less elongate neck, in cross section subcircular; wall smooth, usually transparent; aperture at the end of the elongate neck, which often has a phialine lip.

Length up to 0.8 mm.; diameter up to 0.4 mm.

*Distribution.*—This species from the records would seem to be very common everywhere in the present oceans and in all the geological formations in which Foraminifera occur, but in the North Pacific material examined the species has occurred but a few times. Brady records it from several stations, but none of the figures in the *Challenger* report represent the typical species, and most of them may be referred to other things. All the specimens I have had came from the *Nero* and *Albatross* material dredged off Japan and between there and Guam, in 437 to 2,250 fathoms. Bagg records it from off the Hawaiian Islands and Goës from the western coast of America.

The synonymy of this species is interesting, including a very great range of things, some smooth, others striate, hispid, and variously ornamented, and in form a great many varied shapes are placed here. Without the original material it is useless to try to straighten out this perplexity of figures, as some of them in the older works are more or less conventionalized.

It is interesting to note the lack of records for this species in some of the works of more careful students. From this and my own experience the question of the very general distribution of this species may be raised.

### LAGENA ACUTA (Reuss).

Plate 38, fig. 6.

*Fissurina acuta* REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 340, pl. 7, figs. 90, 91.

*Lagena acuta* FORNASINI, Boll. Soc. Geol. Ital., vol. 7, 1888, p. 47, pl. 3, fig. 6.

*Description.*—Test somewhat elongate, compressed, in front view pyriform, broadest toward the aboral end, tapering gradually to the bluntly pointed apertural end, aboral end with an acutely pointed tip, more or less prominent, wall smooth, aperture elongate elliptical, extending to the central chamber by a fairly long neck.

Length about 0.75 mm.

*Distribution.*—This species seems to be rare in the North Pacific, having been noted but once in the material examined, *Nero* station 10, in 2,098 fathoms, west of the Hawaiian Islands.

This seems to be distinct from the form here referred to *L. sacculus* Fornasini, as the outline is more nearly that of the figures given by Reuss and the exterior is very smoothly sloping without an accentuation of the central chamber as in the species *L. sacculus*.

LAGENA LÆVIGATA (Reuss).

Plate 2, fig. 1.

*Fissurina lævigata* Reuss, Denkschr. Akad. Wiss. Wien, vol. 1, 1849, p. 366, pl. 46, fig. 1; Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 338, pl. 6, fig. 84.—Terquem, Mém. Soc. Géol. France, ser. 3, vol. 2, 1882, p. 30, pl. 1 (9), figs. 17 *a*, *b*.

*Lagena lævigata* Terrigi, Atti Accad. Pont. Nuovi Lincei, vol. 33, 1880, p. 177, pl. 1, fig. 6.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 473, pl. 114, figs. 8 *a*, *b*.—Blackwill and Millett, Journ. Micr., vol. 3, 1884, p. 81, pl. 2, fig. 6.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 330, pl. 10, figs. 64, 65.—Madsen, Medd. fra Dansk. Geol. Forening, No. 2, 1895, pp. 74, 195, pl., fig. 3.—Millett, Journ. Roy. Micr. Soc., 1901, p. 493.—Sidebottom, Mem. Proc. Manchester Lit. and Philos. Soc., vol. 50, No. 5, 1906, p. 5, pl. 1, fig. 6 [?].

*Fissurina globosa* Bornemann, Zeitschr. deutsch. geol. Ges., vol. 7, 1855, p. 317, pl. 12, fig. 4.

*Lagena marginata* Haeusler, Neues Jahrb. für Min., 1887, pt. 1, p. 186, pl. 4, figs. 51, 52 (not *Vermiculum marginatum* Montagu).

*Description.*—Test subglobose, compressed, somewhat pyriform in front view, in cross section elliptical; wall smooth, transparent in thin specimens or opaque in more thickened ones, along the lateral margins usually clear even in thickened specimens; aperture elongate, fairly narrow, connecting with the interior by a fairly long entosolenian neck.

Length up to 1 mm.; breadth slightly less.

*Distribution.*—Brady records this species at four *Challenger* stations in the western and middle North Pacific from 1,850 to 3,125 fathoms in depth. In the material which I have examined it has occurred at many *Nero* and *Tuscarora* stations from the Hawaiian Islands to Japan, the depths varying from 1,186 to 2,086 fathoms.

This species is common everywhere from existing records, yet fails to appear as would be expected in lists from certain regions. This may be due to the fact that the figure in the *Challenger* Report was not placed on the plates with the others but is near the end of the volume and may have been overlooked.

### LAGENA SACCULUS Fornasini.

Plate 3, figs. 1–3.

*Lagena acuta* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 474, pl. 59, figs. 6*a*, *b* (not *L. acuta* (Reuss)).

*Lagena acuta*, var. *sacculus* Fornasini, Mem. Accad. Sci. Ist. Bologna, ser. 5, vol. 9, 1901, p. 49, fig. 3.

*Description.*—Test usually somewhat carinate, body of test in front view nearly circular, in end view broadly elliptical, neck somewhat variable in length and breadth, but varying correspondingly with the development of the carina, which may be very slight or rather well developed according to the specimen; wall smooth, fairly thick, either transparent and distinctly punctate or thickened and nearly opaque, aboral end of test extending out into an acute angled process; aperture at the exterior elongate, elliptical, with a well-developed entosolenian neck extending well into the central cavity of the test, usually with the inner end somewhat expanded, carina when well developed often showing radial lines formed by punctæ extending in from its periphery.

Length up to 0.6 mm.

*Distribution.*—Well distributed in the *Nero* material from the region west of the Hawaiian Islands to Guam and the coast of Japan. The depths of the stations at which this species was taken vary from 1,088 to 2,225 fathoms, most of the stations being more than 1,500 fathoms in depth. There are records for two *Challenger* stations, 241 in 2,300 fathoms and 244 in 1,850 fathoms, both east from Japan.

This is one of the species in which a definite variation seems to occur. In the specimen figured by Fornasini there is little if any keel developed and the external neck is very short and broad. From this the variation is through a series increasing the breadth of the carina and at the same time increasing the length of the neck until in such specimens as that figured by Brady and again in my figure (fig. 3) there is a broad fairly thin keel and a relatively long neck. Throughout the series, however, there is the same shape to the body of the test, circular in front view and broadly elliptical in end view; the external aperture remains elliptical and the entosolenian neck of the same general shape and of fairly uniform length.

Reuss's figure of *Fissurina acuta* shows a specimen with a much more elongate body and an acute apertural end, the whole outline considerably different from our recent specimens, and apparently Fornasini is right in segregating this form from that described by Reuss. Even Brady questioned the identity of the two.

### LAGENA CLAVATA (d'Orbigny).

Plate 2, fig. 3.

*Oolina clavata* d'Orbigny, For. Foss. Vienne, 1846, p. 24, pl. 1, fig. 2.

*Lagena clavata* Mackie, Recreative Science, vol. 1, 1859, p. 148, fig. 13.—Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 320, pl. 1, figs. 13, 14.—Terquem, Mém. Soc. Géol. France, ser. 3, vol. 2, 1882, p. 25, pl. 1 (9), fig. 2.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 456.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 324, pl. 10, fig. 68.—Haeusler, Abh. schweiz. Pal. Ges., vol. 20, 1893, p. 14, pl. 1, figs. 17–22.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 75, pl. 13, figs. 725–727.—Morton, Proc. Portland Soc. Nat. Hist., vol. 2, pt. 4, 1897, p. 116, pl. 1, fig. 2.—Fornasini, Mem. Accad. Sci. Ist. Bologna, ser. 5, vol. 7, 1897 (1898), p. 14 (206), pl., fig. 18.—Wright, in Meade, Geol. Mag., dec. 4, vol. 7, 1900, p. 100, pl. 5, fig. 13.—Millett, Journ. Roy. Micr. Soc., 1901, p. 490.

*Lagena lævis*, var. *amphora* Williamson, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 12, pl. 1, figs. 3, 4.

*Lagena lævis* Haeusler, Neues Jahrb., 1887, pt. 1, p. 181, pl. 4, figs. 39–48; Abh. schweiz. Pal. Ges., vol. 17, 1890, p. 86, pl. 13, figs. 17, 18.

*Lagena vulgaris*, var. *clavata* Williamson, Rec. Foram. Great Britain, 1858, p. 5, pl. 1, fig. 6.

*Lagena lævis*, var. *clavata* Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 478.

*Description.*—Test elongate, clavate or fusiform, with a long neck at the oral end and an elongation of the test somewhat variable in length at the aboral end, surface smooth, cross section nearly circular, wall thin and transparent, aperture nearly circular, at the end of the neck, often with a phialine lip.

Length up to 1 mm.

*Distribution.*—Apparently this species is not definitely recorded from the North Pacific. The only material I have had referable to this species was from *Nero* station 1466 in 234 fathoms near Guam.

### LAGENA LATERALIS, new species.

Plate 1, fig. 1.

*Description.*—Test elongate, somewhat compressed, broadest toward the basal end, apertural end somewhat tapering, both ends broadly rounded, the basal end somewhat truncate, end view oval; wall smooth, transparent or nearly so, the flattened sides closely set with punctæ, the lateral margins without punctæ, aperture lateral, at one side below the apex, elongate, elliptical with lip-like margins, with a long entosolenian neck more than half the length of the test, flaring at its inner end.

Length about 0.45 mm.; broadest diameter about 0.2 mm.

*Distribution.*—Type-specimen, Cat. No. 8524, U.S.N.M., from *Albatross* D4974 in 905 fathoms off Yokohama, Japan. Specimens

also occurred at several *Nero* stations and one *Tuscarora* station between Guam and Yokohama in 660 to 2,104 fathoms. There was little variation observed in the specimens from these six stations.

The specimens figured by Brady [1] may very probably belong to this species. They have the broad-lipped aperture at one side of the axis while Reuss's examples of *L. apiculata* have a definite stellate aperture.

#### LAGENA COLLARIS, new species.

Plate 1, fig. 2.

*Description.*—Test elongate, ovoid in front view, widest near the aboral end, apertural end with a deep constriction somewhat in from the actual end; cross section circular, wall thin, transparent, smooth; aperture nearly circular, opening into a separate cavity which connects with the larger part of the test by a short entosolenian tube.

Length 0.35 mm.; breadth 0.2 mm.

*Distribution.*—Type-specimen, Cat. No. 8525, U.S.N.M., from *Nero* station 1147 in 1,856 fathoms, midway between Yokohama and Guam.

The external constriction in the test seems to really mark the apex of the test and the small portion above is a supra-added chamber-like portion of the test with its own aperture to the exterior. From the level of the constriction or slightly above there is a short entosolenian tube passing downward into the main cavity of the test.

#### LAGENA FELSINEA Fornasini.

Plate 4, fig. 1.

*Lagena vulgaris*, var. (*Entosolenia*) *globosa* Rymer-Jones, Trans. Linn. London, vol. 30, 1872, pl. 19, fig. 2 (not *L. globosa* (Montagu)).

*Lagena apiculata* H. B. Brady (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 56, fig. 4.

*Lagena emaciata*, var. *felsinea* Fornasini, Mem. Accad. Ist. Bologna, ser. 5, vol. 9, 1901, p. 47, fig. 1.

*Description.*—Test elongate; subcylindrical, arcuate in side view especially toward the apertural end, aboral end broader, rounded or slightly acute; wall thin, smooth, aperture eccentric, rounded, with a long entosolenian neck somewhat inflated at its inner end.

Length about 0.7 mm.; diameter about 0.25 mm.

*Distribution.*—Specimen figured from *Nero* station 1012 in 1,932 fathoms between Guam and Japan. The specimen figured by Rymer-Jones was from the region of Java. Fornasini's original specimen is from the Mediterranean region.

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[1] Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 56, figs. 17, 18.

### LAGENA GRACILLIMA (Seguenza).

Plate 1, fig. 4.

*Amphorina gracilis* Costa, Atti Accad. Pontiniana, vol. 7, 1856, p. 121, pl. 11, fig. 11.

*Amphorina gracillima* Seguenza, Foram. mon. Mioc. Messina, 1862, p. 51, pl. 1, fig. 37.

*Lagena gracillima* Jones, Parker, and H. B. Brady, Pal. Soc. Mon., vol. 19, 1866, p. 45, pl. 1, figs. 36, 37.—H. B. Brady, Ann. Mag. Nat. Hist., ser. 4, vol. 6, 1870, p. 292, pl. 11, figs. 6*a–c*.—Butschli, in Bronn, Klassen und Ordnungen Thier-Reichs, vol. 1, 1880, p. 197, pl. 7, fig. 20.—Fornasini, Boll. Soc. Geol. Ital., vol. 2, 1883, p. 185, pl. 2, fig. 5.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 456, pl. 56, figs. 21, 22, 24–26 [19? 20? 23? 27? 28?].—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 330, pl. 10, fig. 12.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 75, pl. 13, fig. 729 (not 728, 730); Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 52.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 306, pl. 53, fig. 3.—Silvestri, Mem. Pont. Accad. Nuovi Lincei, vol. 17, 1900, p. 245, pl. 6, fig. 42.—Millett, Journ. Roy. Micr. Soc., 1901, p. 491.

*Lagena sulcata*, var. *distoma-polita* Parker and Jones, Philos. Trans., vol. 155, 1865, p. 357, pl. 13, fig. 21; pl. 18, fig. 8.

*Lagena lævis*, var. *gracillima* Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 478.

*Description.*—Test much elongate, slender, broadest near the middle, thence tapering toward either end and continued out into a long slender tubular neck at each end, apertural end with a definite rim at the apex when complete and the opposite end probably closed in perfect specimens, delicate, wall thin and hyaline, smooth; transparent.

Length up to 1.5 mm.

*Distribution.*—This species is recorded by Brady from three *Challenger* stations; 206 in 2,100 fathoms in the China Sea; 241 in 2,300 fathoms east of Japan; and 232 in 345 fathoms on the *Hyalonema*-ground south of Japan. Goës records it from three *Albatross* stations off the west coast of America in 782, 1,132, and 1,832 fathoms. In the material I have had the species has occurred in these same two regions, *Albatross* D4775 in 584 fathoms and D4964 in 37 fathoms, both off Japan, and *Tuscarora* station 9, in 980 fathoms off southern California.

Although this species is usually described as having an aperture at both ends it seems to me that this is accidental, and that in perfect specimens the aboral end will be found to be closed. Owing to the extreme tenuity of the ends and the fragile character of the wall, the perfect aperture with its prominent lip is seen in but a small per cent of the specimens examined. This is apparently due to breakage in handling the material. The same is probably true of the aboral end, for no trace of a lip or other indication of a finished end is noted either in specimens or figures of this species. The

complete apertural end is shown in the accompanying figure and in the figure given by Parker and Jones (pl. 18, fig. 8). There may be gradations between this species and *Lagena elongata*, but as far as seen *L. gracillima* has the main portion of the test decidedly fusiform, while in *L. elongata* the sides are usually nearly parallel for a considerable portion of their length.

The specimen figured by Flint, which in his figure (pl. 53, fig. 3) is shown as the second specimen from the left side, is the most perfect I have seen and shows the perfect apertural lip and the almost perfect aboral end terminating in a very delicately pointed tip. Some of the other specimens in this set had perhaps best be referred to *L. elongata*.

**LAGENA ELONGATA (Ehrenberg).**

Plate 1, fig. 5.

*Miliola elongata* Ehrenberg, Bericht preuss. Akad. Wiss. Berlin, 1844, p. 274, 1845, p. 371; Mikrogeologie, 1854, pl. 25, fig. 1.

*Lagena elongata* Tate and Blake, Yorkshire Lias, 1876, p. 454, pl. 18, figs. 9, 9*a*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 457, pl. 56, fig. 29.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 75, pl. 13, fig. 731.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 306, pl. 53, fig. 1.—Millett, Journ. Roy. Micr. Soc., 1901, p. 492, pl. 8, fig. 10.—Chapman, Trans. New Zealand Inst., vol. 38, 1905, p. 91.

*Lagena gracillima* (part) H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 56, figs. 27, 28.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, pl. 13, figs. 728, 730 (not 729).

*Lagena vulgaris*, var. *distoma-polita* Rymer-Jones (part), Trans. Linn. Soc. London, vol. 30, 1875, p. 64, pl. 19, fig. 55.

*Description.*—Test much elongate, slender, middle portion cylindrical tapering gradually into slender tubular projections at either end, apertural end when complete with a slightly projecting lip; wall thin and hyaline, smooth; transparent.

Length up to 2.5 mm.

*Distribution.*—This species does not seem to be recorded from the North Pacific. I have found specimens in but two regions in the material I have examined, *Albatross* H4025 in 536 fathoms in Bering Sea and several stations off Japan, depths varying from 44 to 649 fathoms, average 308 fathoms, and bottom temperatures varying from 38.1° F. to 39.9° F. In none of these cases was *L. gracillima* present.

As usually considered, this species is cylindrical in the middle, with nearly parallel sides for a considerable distance, instead of fusiform from the middle as in *L. gracillima*. In rare cases the apertural lip seems to be preserved, but usually specimens are broken close back to the stouter cylindrical portion.

The original figure given by Ehrenberg is a rather poor one, but may be this species. Egger's figure[1] has prominent lines of punctæ which are not typical of this species, and apparently does not belong here.

LAGENA APICULATA (Reuss).

*Oolina apiculata* Reuss, in Haidinger's Nat. Abhandl., vol. 4, 1850, p. 22, pl. 1, fig. 1.

*Lagena apiculata* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, 1862 (1863), p. 319, pl. 1, figs. 4–8, 10, 11.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 453, pl. 56, figs. 4, 15–18.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, 1894, p. 80, pl. 13, fig. 747.—Sidebottom, Journ. Quekett Micr. Soc., vol. 11, 1912, p. 381, pl. 14, figs. 16–18.

*Description.*—Test subglobose, smooth, entosolenian, but slightly if at all compressed, apical end with a pointed spine, variable in length. Length 0.5 mm.

*Distribution.*—This species is recorded in the Summary of Results of the *Challenger* Report at stations in the western Pacific down to 2,300 fathoms. I have had a specimen from *Nero* station 1155 in 1,652 fathoms between Guam and Yokohama.

LAGENA HISPIDA Reuss.

Plate 4, figs. 4, 5; plate 5, fig. 1.

"Sphaerulæ hispidæ" Soldani, Testaceographia, vol. 2, 1798, p. 53, pl. 17, figs. V, X.

*Lagena hispida* Reuss, Zeitschr. deutsch. geol. Ges., vol. 10, 1858, p. 43; Sitz. Akad. Wiss. Wien, vol. 46, 1863, p. 335, pl. 6, figs. 77–79.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 459, pl. 57, figs. 1–4; pl. 59, figs. 2, 5.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 324, pl. 10, fig. 26.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 307, pl. 53, fig. 8.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 141.—Sidebottom, Journ. Quekett Micr. Soc., vol. 11, 1912, p. 385, pl. 14, fig. 31; pl. 15, figs. 1, 2.

*Description.*—Test variously formed, globular to pyriform, the surface clothed with delicate spines uniformly distributed over the test. Length 0.4 to 0.8 mm.

*Distribution.*—Brady records this species at a single *Challenger* station in the North Pacific off Japan in 345 fathoms. Bagg records it from the vicinity of the Hawaiian Islands, *Albatross* station H4585 in 689 fathoms. I have material from *Nero* station 2037 in 55 fathoms off the Hawaiian Islands, 1147 in 1,856 fathoms and *Albatross* D4891 in 181 fathoms, both off Japan.

Figures are here given of two of the modifications noted, the globose form with long tubular projection (pl. 4, fig. 5) and the compressed form (pl. 4, fig. 4) noted by Sidebottom.

[1] Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, pl. 10, fig. 14.

### LAGENA HISPIDULA, new species.

Plate 5, figs. 2, 3.

*Lagena lævis* H. B. Brady (part) (not *L. lævis* (Montagu)), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 56, figs. 10, 11.

*Description.*—Test flask-shaped, broadly rounded at the base, abruptly narrowed above into a long tubular neck, whole surface very finely and evenly hispid; aperture rounded.

Length 0.60 to 0.95 mm.

*Distribution.*—This species occurred in the North Pacific material off the Hawaiian Islands, *Nero* station 2049 in 2,226 fathoms, off Japan, *Albatross* station D4950 in 529 fathoms, bottom temperature 38.9° F., in Gaspar Straits, North Pacific Exploring Expedition, Captain Rodgers, and at several *Nero* stations along the line of soundings between Yokohama and Japan, as follows: 1137 in 2,250 fathoms; 1160 in 1,907 fathoms; 1163 in 2,049 fathoms; 1209 in 660 fathoms; 1264 in 2,080 fathoms (type-locality); 1306 in 1,208 fathoms and 1310 in 518 fathoms.

*Type.*—Cat. No. 8526, U.S.N.M.

This species, which has been included in *Lagena lævis*, has a very characteristic form and is as far as I have observed invariably hispid. In fact in selected material this form has been taken out first with a low-power lens on account of form alone, and has always been found hispid when examined with a higher-power lens. It seems worthy of being separated from the smooth, more pyriform *L. lævis*.

### LAGENA AMPULLA-DISTOMA (Rymer-Jones).

Plate 14, fig. 7.

*Lagena vulgaris* Williamson, var. *ampulla-distoma* Rymer-Jones, Trans. Linn, Soc. London, vol. 30, 1872, p. 63, pl. 19, fig. 52.

*Lagena ampulla-distoma* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 458, pl. 57, fig. 5.—Millett, Journ. Roy. Micr. Soc., 1901, p. 5, pl. 1, fig. 5.—Sidebottom, Journ. Quekett Micr. Soc., vol. 11, 1912, p. 384.

*Description.*—Test subglobular, broadest slightly below the middle, apertural end broadly truncate with a raised rim about the aperture at some distance; apical end with an external tube usually somewhat curved; wall of the test rough granular.

Length 0.4 to 0.6 mm.

*Distribution.*—The only occurrence of this species in the North Pacific material examined is *Nero* station 2037 in 55 fathoms off the Hawaiian Islands.

LAGENA AMPULLA-DISTOMA (Rymer-Jones), var. CRIBROSTOMOIDES, new variety.

Plate 4, fig. 3.

*Description.*—Like the typical, but the aperture a sieve-like plate, with numerous small rounded openings, apical end with numerous spines as well as the apical tubular projection.

Length 0.4 mm.

*Distribution.*—Type-specimen, Cat. No. 8527, U.S.N.M., from *Nero* station 1310 in 518 fathoms between Guam and Yokohama.

This variety shows a rather unusual type of aperture for this genus.

LAGENA HYSTRIX Reuss.

Plate 5, fig. 5.

*Lagena hystrix* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 335, pl. 6, fig. 80.

*Lagena histrix* Terquem, Mem. Soc. Geol. France, ser. 3, vol. 2, 1882, p. 28, pl. 1 (9), fig. 14; ser. 3, vol. 4, 1886, p. 7, pl. 1, fig. 7.

*Description.*—Test flask-shaped, somewhat compressed, broadest at about the middle, neck short; surface with spine-like tubes, open at the end, intermediate spaces punctate.

Length 0.5 mm.

*Distribution.*—Specimens which from their peculiar surface ornamentation seem to belong to this species occurred off Japan, *Nero* station 1294 in 1,417 fathoms and *Albatross* H4878 in 84 fathoms, bottom temperature 51.9° F.

A figure is given showing the surface view of the tubulations. These are apparently not broken spines, as suggested by Brady, but are a definitely developed surface character in the test of this species.

LAGENA PUNCTULATA, new species.

Plate 5, fig. 4.

*Description.*—Test flask-shaped, broadest below the middle, apical end rounded, apertural end gradually tapering to a short neck with a phialine lip; rounded in cross section; surface with an ornamentation consisting of an irregular series of large punctæ or fine pores, with the areas between finely punctate.

Length 0.4 mm.

*Distribution.*—Type-specimen, Cat. No. 8528, U.S.N.M., from *Albatross* station H4878 in 84 fathoms off Japan.

This species is perhaps related to *L. hystrix*, but the ornamentation consists of pores instead of spine-like tubulations.

### LAGENA ASPERA Reuss.

Plate 16, fig. 1.

*Lagena aspera* Reuss, Sitz. Akad. Wiss. Wien, vol. 44, 1861, p. 305, pl. 1, fig. 5; vol. 46, 1863, p. 335, pl. 6, fig. 81.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 457, pl. 57, figs. 7–10.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28 (Sci.), 1885, p. 337, pl. 14, figs. 10–12.—Chapman, Journ. Roy. Micr. Soc., 1893, p. 582, pl. 8, fig. 8.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 325, pl. 10, fig. 11.

*Description.*—Test flask-shaped, usually globular with a short stout neck, surface ornamented with an irregularly placed series of beadlike blunt spines.

Length 0.6 mm.

*Distribution.*—Brady records this species from two *Challenger* stations in the North Pacific in 2,050 and 2,300 fathoms. I have seen it but once, from *Nero* station 172 in 2,086 fathoms near the Midway Islands and 1463 in 951 fathoms near Guam.

In this specimen there is a tendency for the ornamentation on the neck to be linear in its arrangement and a definite phialine lip is present.

### LAGENA SQUAMOSA (Montagu).

Plate 6, fig. 1.

*Vermiculum squamosum* Montagu, Test. Brit., 1803, p. 526, pl. 14, fig. 2.

*Entosolenia squamosa* Williamson, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, pl. 2, fig. 19; Rec. For. Great Britain, p. 12, pl. 1, fig. 29.

*Lagena squamosa* Brown, Ill. Rec. Conch. Great Britain, 1827, pl. 1, fig. 32.—Jones, Parker, and H. B. Brady, Mon. For. Crag, 1866, p. 39, pl. 4, fig. 7.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 471, pl. 58, figs. 28–31.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28 (Sci.), 1885, p. 340, pl. 14, fig. 9.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 326, pl. 10, figs. 58, 59.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, 1894, p. 79, pl. 13, fig. 745.

*Entosolenia globosa*, var. *squamosa* Parker and Jones, Ann. Mag. Nat. Hist., ser. 2, vol. 19, 1857, p. 278, pl. 11, fig. 25.

*Description.*—Test subglobular, broadly rounded at the apical end, bluntly pointed at the apertural end, surface reticulated, the apertural end of each areole being arched, giving the appearance of overlapping scales.

Length 0.25 to 0.50 mm.

*Distribution.*—I have had material of this species from the following North Pacific stations: *Tuscarora* 2, lat. 21° 07′ N.; long. 158° 14′ W., in 1,468 fathoms and 41, lat. 33° 38′ N.; long. 120° 38′ W., in 530 fathoms; *Nero* stations 201 in 1,033 fathoms near the Midway Islands and 1065 in 1,321 fathoms north of Guam; and *Albatross* station D4825 in 120 fathoms off Japan.

This species may be distinguished from *L. hexagona* and its varieties by the form of the reticulations.

### LAGENA HEXAGONA (Williamson).

Plate 6, figs. 2, 3.

*Entosolenia squamosa* MONTAGU, var. *hexagona* WILLIAMSON, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 20, pl. 2, fig. 23; Rec. For. Great Britain, 1858, p. 13, pl. 1, fig. 31.

*Lagena hexagona* SIDDALL, Cat. Brit. Rec. For., 1879, p. 6.—GREEN, Amer. Journ. Micr., vol. 6, 1881, p. 46, pl., fig. 4.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 472, pl. 58, figs. 32, 33.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 326, pl. 10, fig. 60.—SIDEBOTTOM, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 54, No. 16, 1910, p. 17, pl. 2, fig. 3.

*Description.*—Test subglobular, broadly rounded at the apical end, bluntly pointed at the apertural end, surface ornamentation consisting of a reticulate pattern, the areoles of which are hexagonal, either arranged in vertical rows or irregular.

Length 0.25 to 0.50 mm.

*Distribution.*—I have had this species from the following North Pacific stations: *Nero* 1867 in 2,311 fathoms near the Midway Islands; 1603 in 1,733 fathoms and 1294 in 1,417 fathoms between Guam and Yokohama; and *Albatross* D4957 in 437 fathoms and D5054 in 282 fathoms off Japan.

In the specimens examined the arrangement of the reticulations seems usually to be very irregular, but occasionally it assumes vertical lines.

### LAGENA HEXAGONA (Williamson), var. SCALARIFORMIS (Williamson).

Plate 6, fig. 4.

*Entosolenia squamosa* (MONTAGU), var. *scalariformis* WILLIAMSON, Rec. For. Great Britain, 1858, p. 13, pl. 1, fig. 30.

*Lagena scalariformis* REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 333, pl. 5, figs. 69–71.

*Description.*—Test similar in form to *L. hexagona* but differing in the surface ornamentation, which is elongate hexagonal, the vertical sides forming almost continuous costæ, the sides of the reticulations being thick.

Length 0.33 mm.

*Distribution.*—This form was noted at two North Pacific stations: *Tuscarora* 5, lat. 37° 04′ N.; long. 123° 22′ W., in 1,200 fathoms, and *Nero* station 201 in 1,033 fathoms near the Midway Islands.

### LAGENA FOVEOLATA Reuss.

Plate 7, fig. 3.

*Lagena foveolata* REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 332, pl. 5, fig. 65.—MILLETT, Journ. Roy. Micr. Soc., 1901, p. 11, pl. 1, fig. 15.—SIDEBOTTOM, Journ. Quekett Micr. Club, vol. 11, 1912, p. 395, pl. 16, fig. 15.

*Description.*—Test pyriform, broadest toward the base, broadly rounded at the apical end, gradually tapering to the slender neck at the apertural end, surface ornamentation consisting of longitudinal

raised costæ, the furrows between divided transversely by less well-developed transverse costæ.

Length 0.25 mm.

*Distribution.*—Specimens occurred at three *Nero* stations between Guam and Yokohama; 1065 in 1,321 fathoms, 1128 in 1,418 fathoms, and 1301 in 1,088 fathoms. The coarser of these is here figured. The other is much finer in its sculpturing. Both specimens are closer to Reuss's figure than those given by either Millett or Sidebottom.

LAGENA FOVEOLATA Reuss, var. PARADOXA Sidebottom.

Plate 15, fig. 3.

*Lagena foveolata* Reuss (?), var. *paradoxa* Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 395, pl. 16, figs. 22, 23.

*Description.*—Test flask-shaped, elongate, broad and rounded at the aboral end, tapering gradually toward the apertural end; neck short but definite; wall ornamented with longitudinal costæ running the entire length of the test, the inner costal furrows divided transversely by slightly raised lines and the whole furrow occupied by a double row of elongate, fine openings, outer wall tending to disintegrate and flake off, leaving the inner wall of the test exposed and spinose, the spines in longitudinal lines.

Length of North Pacific specimens 1.25 mm.

*Distribution.*—This variety was described from the southwest Pacific. This characteristic ornamentation and disintegration of the test is apparent in material from *Nero* station 2052 in 1,184 fathoms off the Hawaiian Islands.

LAGENA CATENULATA (Williamson).

Plate 7, figs. 1, 2.

*Entosolenia squamosa* Montagu, var. *catenulata* Williamson, Rec. Foram. Great Britain, 1858, p. 13, pl. 1, fig. 31.

*Lagena catenulata* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 332, pl. 6, figs. 74, 75.

*Description.*—Test pyriform, nearly circular in transverse section or polygonal, surface ornamented with prominent longitudinal costæ, with a series of coordinate transverse costæ between, usually horizontal or slightly arched upward.

Length about 0.25 mm.

*Distribution.*—This species occurred at the following North Pacific stations: *Nero*, 1129 in 1,505 fathoms, and 1310 in 518 fathoms, between Guam and Yokohama; also at *Albatross* station, D4843 in 100 fathoms off Japan.

Although the original figure given by Williamson shows a surface ornamentation less regular in character than those figured here,

nevertheless the general character is the same, the transverse and longitudinal costæ being practically of equal prominence and nearly at right angles with one another.

### LAGENA STRIATA (d'Orbigny).

Plate 7, figs. 4, 5.

*Oolina striata* d'Orbigny, Foram. Amér. Mérid., 1839, p. 21, pl. 5, fig. 12.
*Lagena striata* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 327, pl. 3, figs, 44, 45; pl. 4, figs. 46, 47.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 460, pl. 57, figs. 22, 24.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 327, pl. 10, figs. 21–23.

*Description.*—Test flask-shaped, nearly circular in cross section, body of test subglobular, neck variable in length, usually rather abruptly contracted from the body of the test at its base, surface ornamented with numerous rather fine costæ running the entire length of the test, apical end typically broadly rounded, occasionally slightly tapering to a point.

Length 0.25 to 0.75 mm.

*Distribution.*—Bagg records this species from three *Albatross* stations: H4566 in 572 fathoms, H4567 in 1,307 fathoms, and H4694 in 865 fathoms off the Hawaiian Islands. I have had material from *Nero* station, 2049 in 2,226 fathoms off the Hawaiian Islands, 1309 in 891 fathoms between Guam and Yokohama, and at three *Albatross* stations—D4900 in 139 fathoms, D4958 in 405 fathoms, and D5056 in 258 fathoms, all off Japan.

There are many forms of striate Lagenæ, and it is very uncertain from the material I have had at my disposal where to draw lines of demarcation between forms. Unless there have been definite characters which have had some appearance of stability, I have preferred to place them under *L. striata*. Certain other forms have occurred in some numbers and have had rather definite characters, and for these certain names have been used to distinguish them here.

### LAGENA STRIATA (d'Orbigny), var. HAIDINGERI (Czjzek).

Plate 7, fig. 6.

*Oolina haidingeri* Czjzek, Haidinger's Nat. Abhandl., vol. 2, 1847, p. 138, pl. 12, figs. 1, 2.
*Lagena haidingeri* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 326, pl. 3, fig. 41.
*Lagena striata* H. B. Brady (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 57, figs. 29, 30.—Sidebottom (part), Journ. Quekett Micr. Club, vol. 11, 1912, pl. 15, fig. 9.

*Description.*—Variety differing from typical *L. striata* in the neck, which is subconical with several prominent platelike costæ and the apical end with numerous short spines, usually curved outwardly.

Length 0.65 mm.

*Distribution.*—This variety was obtained at *Albatross* station, D2806 in 1,379 fathoms off the Galapagos Islands.

The two added characters of a fluted truncate conical neck with the basal outwardly curving spines seem to be correlated and the form worthy of recognition.

LAGENA STRIATA (d'Orbigny), var. SUBSTRIATA Williamson.

Plate 8, figs. 1–3.

*Lagena substriata* Williamson, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 15, pl. 2, fig. 12.

*Lagena vulgaris*, var. *substriata* Williamson, Rec. For. Great Britain, 1858, p. 7, pl. 1, fig. 14.

*Description.*—Variety differing from the typical in the more elongate body, long tapering neck, costulate surface extending up onto the neck often to its end and usually spirally arranged on the neck.

Length 0.4–0.5 mm.

*Distribution.*—This variety seems to be much more common in the North Pacific than the others. It occurred at *Tuscarora* station 9 in lat. 31° 51′ N.; long. 119° 3′ W., in 980 fathoms. It has also occurred at numerous *Albatross* and *Nero* stations off Japan in depths ranging from 33 to 1,529 fathoms, but one station, however, being over a thousand fathoms.

LAGENA STRIATA (d'Orbigny), var. STRUMOSA Reuss.

Plate 7, figs. 7–10.

*Lagena strumosa* Reuss, Zeitschr. geol. Ges., 1858, p. 434; Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 328, pl. 4, fig. 49.

*Description.*—Test clavate, body portion subglobular or slightly fusiform, ornamented with numerous longitudinal costæ, the apical end prolonged into a stout spine; neck long and comparatively stout, ending in a phialine lip, which is itself prominently costate, neck ornamented with raised annuli either transversely costate or beaded and sometimes spinose between the annuli.

Length up to 0.6 mm.

*Distribution.*—This is again one of the most common varieties of this species, especially in the material from off the coast of Japan. Near the Midway Islands it occurred at *Nero* station 105 in 2,370 fathoms, between the Midway Islands and Guam at *Nero* station 542 in 1,996 fathoms, between Guam and Yokohama at *Nero* stations 1209 in 660 fathoms and 1301 in 1,088 fathoms. It occurred at several *Albatross* stations off Japan, the depths ranging from 84 to 440 fathoms.

LAGENA COSTATA (Williamson).

Plate 9, fig. 6; plate 10, fig. 1; plate 12, fig. 1.

*Entosolenia costata* Williamson, Rec. For. Great Britain, 1858, p. 9, pl. 1, fig. 18.
*Lagena costata* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 329, pl. 4, fig. 54.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28 (Sci.), 1885, p. 338, pl. 14, figs. 10–12.—Millett, Journ. Roy. Micr. Soc., 1901, p. 7, pl. 1, fig. 8.—Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 388, pl. 15, figs. 16–20.

*Description.*—Test subglobular ornamented with a few rather remote ribs or costæ running nearly the length of the test, frequently not reaching the apex, but ending in a ring of spinose projections, aperture small and rounded; costæ most often rounded.

Length 0.25 to 0.50 mm.

*Distribution.*—I have had this species from *Nero* station 165 near the Midway Islands in 2,135 fathoms, between Guam and Yokohama, *Nero* stations 1065 in 1,321 fathoms, and 1306 in 1,208 fathoms, and *Albatross* station D4875 in 59 fathoms off Japan.

LAGENA COSTATA (Williamson), var. AMPHORA Reuss.

Plate 10, figs. 2, 3; plate 12, fig. 2.

*Lagena amphora* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 330, pl. 4, fig. 57.

*Description.*—Test elongate pyriform with a long tapering neck; surface with comparatively few, prominent costæ; aperture small, rounded.

Length 0.4–0.6 mm.

*Distribution.*—This variety was found at the following stations: *Tuscarora* 9, lat. 31° 51′ N.; long. 119° 3′ W., in 980 fathoms; *Tuscarora* 40, lat. 33° 41′ N.; long. 120° 50′ W., in 1,092 fathoms; *Nero* 542 in 1,996 fathoms between the Midway Islands and Guam; at several *Nero* stations between Guam and Yokohama at depths ranging from 891 to 1,632 fathoms; and two *Albatross* stations off Japan, D4825 in 120 fathoms and D4843 in 100 fathoms.

In this form there is much variation in the number of costæ and in the form as shown in the specimens here figured.

LAGENA COSTATA (Williamson), var. POLYGONATA, new variety.

Plate 10, fig. 4.

*Description.*—Test subglobular, apertural end somewhat reduced, base truncate, polygonal in transverse section, angles reduced into longitudinal costæ; apical end with a polygonal depression at which the costæ end; aperture rounded.

Length 0.50 to 0.85 mm.

*Distribution.*—Type-specimen from *Nero* station 173 in 2,111 fathoms southeast of the Midway Islands. It also occurred at *Nero* station 1294 in 1,417 fathoms north of Guam.

*Type.*—Cat. No. 8529, U.S.N.M.

LAGENA DISTOMA Parker and Jones.

Plate 13, figs. 1, 2.

*Lagena lævis* (Montagu), var. *striata* Parker and Jones, Ann. Mag. Nat. Hist., ser. 2, vol. 19, 1857, p. 278, pl. 11, fig. 24 (not *L. striata* (Walker and Boys)).

*Lagena distoma* Parker and Jones in H. B. Brady, Trans. Linn. Soc. London, vol. 24, 1864, p. 467, pl. 48, fig. 6.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 461, pl. 58, figs. 11–15.—Egger, Abh. kön. bay. Wiss. München, Cl. II, vol. 18, 1893, p. 330, pl. 10, fig. 13.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 53.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 306, pl. 53, fig. 5.

*Description.*—Test elongate subcylindrical or elongate fusiform, tapering at either end, wall longitudinally striate; translucent.

Length 1 to 2 mm.

*Distribution.*—Brady records this species in the North Pacific from a single *Challenger* station off Japan in 345 fathoms. Goës records it from the eastern Pacific in 782 to 1,132 fathoms. I have had material from three stations off Japan; *Nero* stations 1305 in 1,289 fathoms and 1309 in 891 fathoms; and *Albatross* D4843 in 100 fathoms, bottom temperature 39.9° F.

Except for its striate surface this species is very close to *L. elongata* (Ehrenberg).

LAGENA SULCATA (Walker and Jacob).

Plate 9, fig. 2.

"Serpula (Lagena) striata sulcata rotundata" Walker and Boys, Test. Min., 1784, p. 2, pl. 1, fig. 6.

*Serpula* (*Lagena*) *sulcata* Walker and Jacob, Adams' Essays, Kanmacher's ed., 1798, p. 634, pl. 14, fig. 5.

*Lagena sulcata* Parker and Jones, Philos. Trans., vol. 155, 1865, p. 351.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 462, pl. 57, figs. 23, 26, 33, 34.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 307, pl. 53, fig. 7.—Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 389, pl. 15, figs. 24, 25.

*Description.*—Test flask-shaped, body portion subglobular, ornamented with numerous plate-like costæ running the length of the test, a few often more prominent than others, rather closely set and numerous, sometimes ending in spinose projections at the apical end; neck variously ornamented by costæ or annular rings.

Length 0.35 to 0.65 mm.

*Distribution.*—The only North Pacific stations from which I have had this species are all from Guam to Japan; off Guam, *Nero* station 1464 in 891 fathoms; between Guam and Yokohama, *Nero* stations 1065 in 1,321 fathoms and 1313 in 1,716 fathoms; and off Japan, *Albatross* station D4957 in 437 fathoms.

**LAGENA SULCATA (Walker and Jacob), var. ALTICOSTATA, new variety.**

Plate 9, fig. 5.

*Description.*—Test subglobular, ornamentation consisting of a few prominent primary costæ high, thin, and plate-like, running from the aperture to the apical end of the test; between these, secondary costæ running only to the base of the neck, the alternating ones of these being shorter; aperture small, rounded.

Length 0.4 mm.

*Distribution.*—Type-specimen, Cat. No. 8530, U.S.N.M., from *Nero* station 991 in 1,143 fathoms off Guam. It also occurred at *Nero* station 1466 in 234 fathoms in the same vicinity.

**LAGENA SULCATA (Walker and Jacob), var. APICULATA, new variety.**

Plate 9, figs. 3, 4.

*Lagena sulcata*, apiculate forms, H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 58, figs. 4, 17 (?).

*Description.*—Test like typical *L. sulcata*, but the apical end drawn out into a stout spine; aperture rounded.

Length 0.60–0.85 mm.

*Distribution.*—This variety occurred at *Nero* station 172 in 2,086 fathoms near the Midway Islands and at several *Nero* stations between Yokohama and Guam at depths ranging from 1,299 to 1,737 fathoms. It also occurred at two *Albatross* stations off Japan, D4807 in 44 fathoms and D5054 in 282 fathoms.

*Type-specimen.*—Cat. No. 8531, U.S.N.M., from *Nero* station 1440 in 1,737 fathoms.

**LAGENA ACUTICOSTA Reuss.**

Plate 8, figs. 9, 10; plate 23, fig. 2.

*Lagena acuticosta* Reuss, Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, 1861 (1862), p. 305, pl. 1, fig. 4; vol. 46, pt. 1, 1862 (1863), p. 331, pl. 5, fig. 63.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 464, pl. 57, figs. 31, 32; pl. 58, figs. 20 (?), 21.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 222, pl. 44, figs. 26, 31.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 329, pl. 10, figs. 47, 48, 82, 83.—Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 388, pl. 15, fig. 22.

*Description.*—Test subglobular to pyriform, broadest toward the base and gradually tapering upward toward the apex; apertural end of the test smooth and unornamented, lower portion with comparatively few, thin, much elevated costæ running to the apical end of the test; aperture rounded.

Length 0.25 to 0.50 mm.

*Distribution.*—Brady mentions the occurrence of this species in the North Pacific. From the material I have been able to examine the

species seems to be well distributed in the area, occurring at the following stations: *Albatross* H4857 in 324 fathoms in Bering Sea; H2922 in 268 fathoms off the Hawaiian Islands; *Nero* 991 in 1,143 fathoms off Guam; *Nero* 862 in 1,550 fathoms off Luzon; *Nero* 1160 in 1,907 fathoms between Guam and Yokohama; and two *Albatross* stations off Japan, H4878 in 84 fathoms and D4975 in 712 fathoms.

LAGENA ACUTICOSTA Reuss, var. PAUCICOSTATA, new variety.

Plate 9, fig. 1.

*Lagena acuticosta* SIDEBOTTOM (part), Journ. Quekett Micr. Club, vol. 11, 1912, p. 388, pl. 15, fig. 23 (not fig. 22).

*Description.*—Test more globular than in the typical, the costæ reduced to three, remaining portion of the test smooth; aperture very small, rounded.

Length 0.33 mm.

*Distribution.*—Type-specimen, Cat. No. 8532, U.S.N.M., from *Albatross* station D4887, in 71 fathoms off Japan.

This agrees well with the variety figured by Sidebottom as noted above, the three costæ forming the whole of the ornamentation of the test. In our specimen the costæ do not continue to the apertural end, though they do in the specimen figured by Sidebottom.

LAGENA GRACILIS Williamson.

Plate 8, figs. 5, 6.

*Lagena gracilis* WILLIAMSON, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 13, pl. 1, figs. 3, 4.—REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 2, 1862 (1863), p. 331, pl. 4, figs. 58–61; pl. 5, fig. 62.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 464, pl. 58, figs. 19, 22–24.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 328, pl. 10, figs. 25, 49.

*Lagena vulgaris*, var. *gracilis* WILLIAMSON, Rec. For. Great Britain, 1858, p. 7, pl. 1, figs. 12, 13.

*Description.*—Test elongate, fusiform, ornamented with 4 to 12 or more high costæ or plate-like ribs running the entire length of the test from near the aperture to the apical end, where they unite in an apical spine; neck slender, aperture small, rounded.

Length up to nearly 1 mm.

*Distribution.*—This species was found at numerous *Nero* stations between Yokohama and Guam, the depths ranging from 518 to 1,915 fathoms. It occurred off Guam, *Nero* station 1464 in 891 fathoms, and between Guam and Midway Islands, *Nero* station 542 in 1,996 fathoms. It also occurred at *Tuscarora* station 47, lat. 24° 21′ N.; long. 154° 06′ E., in 1,499 fathoms.

These North Pacific examples are very constant in their form and ornamentation, being of the form here figured. The number of costæ is somewhat variable.

LAGENA GRACILIS Williamson, var.

Plate 8, fig. 7.

*Description.*—Test elongate, the body of the test with numerous costæ, the apertural end with comparatively few, plate-like costæ independent of the costæ of the body.

Length 0.4 mm.

*Distribution.*—Figured specimen from *Nero* station 1294 in 1,417 fathoms between Guam and Yokohama.

LAGENA INFEROCOSTATA, new species.

Plate 8, fig. 8.

*Description.*—Test elongate, subcylindrical or fusiform, central portion with nearly parallel sides, abruptly pointed at either end; lower portion costate, the coarse costæ meeting in a ring at the base of the test; upper portion of test without costæ, nearly smooth except for a reticulation of irregularly placed depressions; aperture circular, without a definite neck.

Length 0.35 mm.

*Distribution.*—Type-specimen, Cat. No. 8533, U.S.N.M., from *Nero* station 1073 in 1,208 fathoms between Yokohama and Guam.

This species is remotely related to *L. acuticosta* in some of its characters.

LAGENA MUCRONULATA Reuss.

Plate 8, fig. 4.

*Lagena mucronulata* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 329, pl. 4, fig. 52.

*Description.*—Test fusiform, the apical end tapering into a short spinose projection; the apertural end with a short neck ending in a subglobular portion, the neck below being somewhat annular, surface ornamented with a few coarse costæ extending from a rim below the neck to the apical end.

Length 0.5 mm.

*Distribution.*—This species was found at *Nero* station 1064 between Guam and Yokohama in 1,588 fathoms.

The peculiar form of the test and the shape of the apertural end of the neck seem to be distinctive features.

LAGENA PLUMIGERA H. B. Brady.

Plate 12, fig. 4.

*Lagena plumigera* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 62; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 465, pl. 58, figs. 25, 27.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 329, pl. 10, figs. 37, 38.—Millett, Journ. Roy. Micr. Soc., 1901, p. 490, pl. 8, fig. 8.

*Description.*—Test flask-shaped, broadest near the base tapering to a long slender neck; wall ornamented with seven to twelve longitudinal

costæ, plate-like at the aboral end of the test spreading into wing-like expansions showing transverse striations.

Length 0.60 to 0.75 mm.

*Distribution.*—This species does not seem to have been previously reported from the North Pacific. Typical specimens were obtained in material from two *Nero* stations; 1117 in 2,123 fathoms and 1294 in 1,417 fathoms, between Yokohama and Guam.

Nearly all the records for the distribution of this species are in deep water and these two are no exceptions to the rule. Most of the stations are in tropical or subtropical waters but the depth at which the species has occurred precludes any influence of temperature in the distribution.

LAGENA STELLIGERA H. B. Brady.

Plate 12, fig. 3.

*Lagena stelligera* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 60; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 466, pl. 57, figs. 35, 36.—Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 391, pl. 15, figs. 28, 29; pl. 16, figs. 1–4.

*Description.*—Test pyriform, broadest near the middle, tapering toward the truncate base and toward the obtusely pointed apertural end; aboral end of the test with a central raised circular rim from the periphery of which radiate eight to twelve short acute costæ extending a short distance up the basal portion of the test; wall smooth above or with slight crenulations about the aperture; the wall about the neck often with darker concentric circles of a slightly darker color.

Length 0.5 to 0.8 mm.

*Distribution.*—This species is recorded by Brady in the *Challenger* Report from deep water in the North Pacific Ocean in 2,300 fathoms. I have had specimens from three *Nero* stations between Yokohama and Guam, 1128 in 1,418 fathoms; 1294 in 1,417 fathoms, and 1318 in 1,210 fathoms.

In the work above quoted Sidebottom refers many variations to this species but in the material I have seen from these stations the specimens correspond very closely with the figures given by Brady, as will be seen from the specimen figured here.

LAGENA CRESCENTICOSTATA, new species.

Plate 17, figs. 1, 2.

*Description.*—Test ovate, widest below the middle, aboral end subtruncate, much compressed, surface with a broad flange-like extension ornamented with interrupted costæ, central portion of the test separated from the flange by a raised crescentiform ridge open at the aboral end, the central area ornamented by interrupted costæ, aperture with a short tapering neck.

Length 0.75 to 1.00 mm.

*Distribution.*—Type-specimens, Cat. No. 8534, U.S.N.M., from *Tuscarora* station 23, lat. 21° 40′ N.; long. 179° 20′ E., in 1,964 fathoms.

The ornamentation of this species is a peculiar one composed of the prominent oval ring and the irregular broken costæ of the rest of the test.

LAGENA STRIATO-AREOLATA Rymer-Jones.

Plate 14, figs. 5, 6.

*Lagena vulgaris* Williamson, var. *striato-areolata* Rymer-Jones, Trans. Linn. Soc., London, vol. 30, 1872, p. 53, pl. 19, figs. 21, 21*a*.

*Lagena striato-areolata* Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 390, pl. 15, fig. 27.

*Description.*—Test flask-shaped, neck long and slender, upper portion of test with four costæ becoming tubular or punctate below, intermediate portion composed of an irregular, generally hexagonal, net-work.

Length 0.5 mm.

*Distribution.*—The single specimen, which compares very favorably with the figure given by Sidebottom noted above, is from *Nero* station 172 in 2,086 fathoms, between the Hawaiian and Midway Islands.

LAGENA TORQUATA H. B. Brady.

Plate 11, fig. 3.

*Lagena torquata* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 62; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 469, pl. 58, fig. 41.

*Description.*—Test flask-shaped, neck long and slender, surface of test with a series of prominent primary longitudinal costæ with punctæ or tubulations down the middle of each, between each pair of primary costæ secondary costæ, imperforate, shorter and less prominent, and transversely finer ribs, breaking the whole up into a reticulate pattern.

Length 0.50 to 0.75 mm.

*Distribution.*—The only station at which this form occurred in the North Pacific material is *Nero* station 1122 in 1,926 fathoms, between Yokohama and Guam.

This species is close to *L. desmophora* and represents a higher development of the surface ornamentation in the transverse ribs and consequent reticulation of the surface.

LAGENA DESMOPHORA Rymer-Jones.

Plate 12, fig. 5; plate 13, fig. 3.

*Lagena vulgaris* Williamson, var. *desmophora* Rymer-Jones, Trans. Linn. Soc. London, vol. 30, 1872, p. 54, pl. 19, figs. 23, 24.

*Lagena desmophora* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 468, pl. 58, figs. 42, 43.—Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 394.

*Description.*—Test flask-shaped, neck long and slender, surface ornamented with several longitudinal, primary costæ with tubulations,

between which are usually secondary costæ, solid and nontubulated, aboral end with or without a spine or series of spines at the ends of the primary costæ.

Length 0.60 to 0.85 mm.

*Distribution.*—Brady records this species from a single North Pacific *Challenger* station in 1,850 fathoms. I have had specimens from several *Nero* stations; one between the Hawaiian and Midway Islands, 165 in 2,135 fathoms and the following stations in the lines of soundings between Guam and Yokohama; 1063 in 1,884 fathoms; 1145 in 2,119 fathoms; 1158 in 1,584 fathoms; 1301 in 1,088 fathoms; 1312 in 1,552 fathoms and 1323 in 1,583 fathoms.

The more simple of the specimens here figured may be perhaps closely related to *L. striato-punctata* in that it lacks the secondary costæ, but those costæ which are present are decidedly catenulate in character and I have included it here.

#### LAGENA EXSCULPTA H. B. Brady.

Plate 13, fig. 5.

*Lagenulina sulcata* TERQUEM (not *Lagena sulcata* (Walker and Jacob)), Essai Animaux plage Dunkerque, pt. 2, 1876, p. 68, pl. 7, fig. 9.

*Lagena exsculpta* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 61; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 467, pl. 58, fig. 1; pl. 61, fig. 5.—SIDEBOTTOM, Journ. Quekett Micr. Club, vol. 11, 1912, p. 392.

*Description.*—Test subglobular or pyriform, rounded or compressed, apertural half of test smooth and unornamented, aboral half ornamented with numerous costæ, not raised above the surface of the remaining portion of the test, but made by the sculpturing of the intermediate areas.

Length 0.5 to 1.2 mm.

*Distribution.*—Brady records this from a single *Challenger* station in the North Pacific in 2,300 fathoms. I have had material from four *Nero* stations between Guam and Yokohama as follows: 1294 in 1,417 fathoms; 1295 in 1,415 fathoms; 1305 in 1,289 fathoms; and 1315 in 1,494 fathoms. All the *Challenger* records are in comparatively deep water.

All the North Pacific material which I have examined is of the compressed form figured by Brady.[1] Sidebottom notes that his South Pacific material is also of this same compressed form.

[1] Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 61, fig. 5.

LAGENA INTERMEDIA Sidebottom.

Plate 13, fig. 4.

*Lagena semistriata?* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 465, pl. 57, fig. 20.

*Lagena intermedia* Sidebottom, Journ. Quekett Micr. Soc., vol. 11, 1912, p. 399, pl. 17, figs. 1–3.

*Description.*—Test pyriform, broadest near the base, circular in cross section; surface smooth, except the basal portion, which has an irregular series of costæ radiating from the center of the base; aperture fissurine.

Length 0.5 mm.

*Distribution.*—This species has occurred at but a single station, *Nero* 1163 in 2,049 fathoms between Guam and Yokohama.

This agrees very closely with some of the figures given by Sidebottom and with the figure in the *Challenger* Report, but the specimen here figured has also a secondary apical radiating group of costæ below the rim. In this regard this specimen is almost intermediate between the rounded specimens of *L. exsculpta* and *L. intermedia*. However, in its general characters this seems decidedly to belong to *L. intermedia*.

LAGENA FEILDENIANA H. B. Brady.

Plate 15, figs. 1, 2.

*Lagena feildeniana* H. B. Brady, Ann. Mag. Nat. Hist., ser. 5, vol. 1, 1878, p. 434, pl. 20, fig. 4; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 469, pl. 58, figs. 38, 39.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 328, pl. 10, fig. 100.

*Description.*—Test elongate, ovate, broad and rounded at the aboral end, tapering nearly to a point at the apertural end; surface ornamentation made up of numerous acute raised costæ running longitudinally the entire length of the test, the surface between consisting of longitudinal furrows each with a series of perforations, each in a slight depression and ovate in shape, the narrow end toward the apertural end of the test.

Length about 1 mm.

*Distribution.*—Brady records this species in the North Pacific from a single *Challenger* station in 2,300 fathoms. I have had it from a single *Albatross* station, D5085, in Sagami Bay, Hondo, Japan, in 622 fathoms, bottom temperature 37.8° F.

With a high-power lens to bring out the details of the ornamentation this is one of the most beautiful species of *Lagena*. The ornamentation is simple, but the delicacy of the sculpturing is really beautiful. This seems to be described by Sidebottom.[1] as *Lagena hertwigiana* H. B. Brady, var. *undulata* Sidebottom.

[1] Journ. Quekett Micr. Club, vol. 11, 1912, p. 397, pl. 16, figs. 26–28.

### LAGENA STRIATO-PUNCTATA Parker and Jones.

Plate 14, fig. 10.

*Lagena sulcata*, var. *striato-punctata* Parker and Jones, Philos. Trans., vol. 155, 1865, p. 350, pl. 13, figs. 25–27.

*Entosolenia striato-punctata* G. M. Dawson, Can. Nat., vol. 5, 1870, p. 178, woodcut, p. 180, fig. 11.

*Lagena striato-punctata* H. B. Brady, Ann. Mag. Nat. Hist., ser. 5, vol. 1, 1878, p. 434, pl. 20, fig. 3; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 468, pl. 58, figs. 37, 40.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28 (Sci.), 1885, p. 339, pl. 14, fig. 20.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 327, pl. 10, figs. 35, 36, 44–46.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, 1894, p. 83, pl. 13, fig. 753.—Millett, Journ. Roy. Micr. Soc., 1901, p. 489, pl. 8, fig. 6.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 54, No. 16, 1910, p. 17, pl. 2, fig. 5; Journ. Quekett Micr. Club, vol. 11, 1912, p. 392, pl. 16, figs. 7–10.

*Description.*—"Test oval pyriform, or flask-shaped, and either ecto- or entosolenian. It is decorated externally with tolerably stout longitudinal costæ, from 6 to 20 in number, bearing conspicuous pseudopodial foramina. The perforations are placed either in single rows down the middle of the costæ, or in double lines, one on each side, in their thickened bases."

Length 0.3 mm.

*Distribution.*—Brady records this species from *Challenger* station 241 in 2,300 fathoms.

### LAGENA FIMBRIATA H. B. Brady.

Plate 14, fig. 8.

*Lagena fimbriata* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 61; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 486, pl. 60, figs. 26–28.

*Lagena orbignyana* (?) Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 418, pl. 21, fig. 15.

*Description.*—"Test pyriform or flask-shaped, broad at the base, compressed; ento- or ecto-solenian; furnished with a deep vertical wing, encircling the oval base; the wing traversed by parallel tubuli, and sometimes fringed at the free margin."

Length 0.42 mm.

*Distribution.*—Among other stations Brady records this species from a *Challenger* station in the North Pacific in 2,300 fathoms.

The figure quoted above from Sidebottom's work on the Lagenæ of the Southwest Pacific seems possibly to be this same species, or at least closely related to it.

### LAGENA STAPHYLLEARIA (Schwager).

Plate 17, fig. 3.

*Fissurina staphyllearia* Schwager, *Novara*-Exped., Geol. Theil, vol. 2, 1866, p. 209, pl. 5, fig. 24.

*Lagena staphyllearia* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 474, pl. 59, figs. 8–11.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 331, pl. 10, figs. 50, 51, 99.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 307, pl. 54, fig. 1.—Millett, Journ. Roy. Micr. Soc., 1901, p. 619, pl. 14, fig. 2.—Sidebottom, Mem. Proc. Manchester Lit. and Philos. Soc., vol. 50, No. 5, 1906, p. 8, pl. 1, figs. 18–20; Journ. Quekett Micr. Soc., vol. 11, 1912, p. 403, pl. 17, figs. 19–24.

*Lagena vulgaris*, var. *spinicosto-marginata* Rymer-Jones, Trans. Linn. Soc. London, vol. 30, 1872, p. 57, pl. 19, figs. 34–36.

*Description.*—Test ovate, compressed, wall smooth, periphery keeled usually, with several spines symmetrically arranged about the border; aperture fissurine.

Length about 0.5 mm.

*Distribution.*—Apparently this species has not previously been recorded from the North Pacific. It has occurred at three *Nero* stations; 91 in 1,983 fathoms and 170 in 1,990 fathoms between the Hawaiian and Midway Islands and 862 in 1,550 fathoms off Luzon, Philippine Islands.

Both three- and five-spined specimens occur, but the range of variation shown by Sidebottom does not seem to exist in our specimens. The figured specimen is very similar to the one figured by Sidebottom as *Lagena fasciata* Egger, var. *spinosa* Sidebottom,[1] but our specimen lacks the ornamentation of *L. fasciata*. Otherwise the two are very similar.

### LAGENA TRUNCATA H. B. Brady.

Plate 19, fig. 3.

*Lagena truncata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 457, pl. 56, figs. 31, 32.

*Description.*—Test elongate, pyriform; greatest breadth below the middle, aboral end broadly rounded; apertural end obtusely rounded; wall smooth; aboral end with two or more short spines; aperture radiate.

Length 0.4 to 1.0 mm.

*Distribution.*—This species occurred in material from *Nero* station 1065 in 1,321 fathoms between Guam and Yokohama.

Brady speaks of the aperture as "either round or fissurine" but the specimen figured has a decidedly radiate aperture. The optical section gives the form and comparative length of the entosolenian tube.

[1] Journ. Quekett Micr. Club, vol. 11, 1912, p. 402, pl. 17, fig. 17.

LAGENA UNGUICULATA H. B. Brady.

Plate 11, fig. 1.

*Lagena unguiculata* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 61; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 474, pl. 59, fig. 12.

*Description.*—"Test pyriform, compressed; inferior end broad and tapering to a thin edge, which is furnished with a number of more or less curved teeth symmetrically set."

Length 0.35 mm.

*Distribution.*—On page 876 of the volume on the "Summary of Results of the Challenger Report," this species is recorded from station 224 in 1,850 fathoms.

This seems to be the only North Pacific record.

LAGENA AURICULATA H. B. Brady, var. COSTATA H. B. Brady.

Plate 14, fig. 2.

*Lagena auriculata* H. B. Brady, var. *costata* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 61; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 487, pl. 60, fig. 38.—Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 422, pl. 20, figs. 21, 22.

*Description.*—Variety with the body of the test costate and also carinate.

Length 0.25 mm.

*Distribution.*—Brady records this species from a single *Challenger* station in the North Pacific in 2,300 fathoms.

The figure is from the *Challenger* Report

LAGENA AURICULATA H. B. Brady, var. SUBCARINATA, new variety.

Plate 17, fig. 4.

*Lagena auriculata* H. B. Brady, var., Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 421, pl. 20, figs. 15–18.

*Description.*—Test ovate, somewhat compressed, central portion somewhat irregularly roughened, basal portion or whole test with a wide peripheral keel with two tubular projections from the lower border; entosolenian tube long and sinuous.

Length about 0.25 mm.

*Distribution.*—This variety occurred at *Nero* station 1300 between Guam and Yokohama, type-specimen, Cat. No. 8535, U.S.N.M., and at *Albatross* station D4957 in 437 fathoms off Japan.

This is the variety noted without name by Sidebottom. It seems worthy of some distinctive name that its distribution may be noted.

LAGENA AURICULATA H. B. Brady, var. LINEARITUBA, new variety.

Plate 17, fig. 5.

*Lagena auriculata* H. B. Brady (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 487, pl. 60, fig. 31.

*Description.*—Test elongate, ovate, broadest below the middle, apical end broadly rounded, apertural end gradually tapering to an obtuse point; surface smooth, lateral tubulations much elongated and very shallow; aperture radiate.

Length 0.5 mm.

*Distribution.*—Type-specimen, Cat. No. 8536, U.S.N.M., from *Nero* station 1294 between Guam and Yokohama in 1,417 fathoms

This is the form referred by Brady to this species with a question.

LAGENA ALVEOLATA H. B. Brady.

Plate 18, fig. 1.

*Lagena alveolata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 487, pl. 60, figs. 30, 32.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 50, No. 5, 1906, p. 15, pl. 2, fig. 17; Journ. Quekett Micr. Club, vol. 11, 1912, p. 424, pl. 21, figs. 1, 2.

*Description.*—"Test pyriform compressed, lateral edges obtuse or rounded; base broad and round in outline, rarely mucronate; furnished with a median and two lateral carinae, which unite so as to form two loops on each side of the test, usually separated by a central depression."

Length 0.3 to 0.5 mm.

*Distribution.*—Brady records this species from a single station in the North Pacific in 2,300 fathoms. I have had the typical form from three *Nero* stations between Guam and Yokohama; 1065 in 1,321 fathoms, 1155 in 1,632 fathoms and 1440 in 1,737 fathoms.

The species seems to occur nearly always in deep water as noted by Brady. This typical form of the species is small, the test subtransparent, the loops entirely at the sides, very different from the following.

LAGENA ALVEOLATA H. B. Brady, var. PLEBEIA, new variety.

Plate 18, fig. 2.

*Description.*—Test larger than the typical, coarser, opaque, walls thick, the three keels separated from one another, forming two gaping depressions at either side of the median keel, margins roughened, apertural end much like the typical.

Length 0.5 to 0.9 mm.

*Distribution.*—This form is by far the most common of the species in the North Pacific. It occurred at *Nero* station 170 in 1,990 fathoms, southeast of the Midway Islands, and at 10 stations between Guam and Yokohama, in depths varying from 1,040 to 2,250 fathoms.

*Type-specimen.*—Cat. No. 8537, U.S.N.M., from *Nero* station 1160 in 1,907 fathoms. It also occurred at *Tuscarora* station 2 in lat. 21° 07′ N.; long. 158° 14′ W. in 1,468 fathoms.

LAGENA ALVEOLATA H. B. Brady, var. SUBSTRIATA H. B. Brady.

Plate 18, fig. 5.

*Lagena auriculata* H. B. Brady, var. *substriata* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 61.

*Lagena alveolata* H. B. Brady, var. *substriata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 488, pl. 60, fig. 34.—Sidebottom, Journ. Quekett Micr. Soc., vol. 11, 1912, p. 424.

*Description.*—Variety characterized by the body portion of the test being striate or costate, especially about the base and somewhat less so toward the apertural end.

Length 0.60 mm.

*Distribution.*—I have had specimens of this variety from *Tuscarora* station 5, lat. 37° 04′ N.; long. 123° 22′ W., in 1,200 fathoms and from four *Nero* stations between Guam and Yokohama as follows: 1299 in 1,817 fathoms, 1301 in 1,088 fathoms, 1320 in 2,048 fathoms, and 1324 in 1,915 fathoms.

The basal costæ in this variety seem not to extend up beyond the lower half of the test.

LAGENA ALVEOLATA H. B. Brady, var. BASIEXCAVATA, new variety.

Plate 18, fig. 4.

*Description.*—Variety characterized by two costæ on each side in the middle of the inferior half of the test, each forking near the periphery and the two angles thus formed excavated.

Length 0.75 mm.

*Distribution.*—Type-specimen Cat. No. 8538, U.S.N.M., from *Nero* station 1185 in 1,491 fathoms between Yokohama and Guam.

The peculiar costæ and basal excavations will distinguish this variety.

LAGENA ALVEOLATA H. B. Brady, var. PROLONGATA, new variety.

Plate 18, fig. 3.

*Description.*—Variety differing from the others by having a much elongated neck instead of the typical bluntly pointed test.

Length 0.65 mm.

*Distribution.*—Type-specimen Cat. No. 8539, U.S.N.M., from *Nero* station 1299 in 1,817 fathoms between Yokohama and Guam.

All other forms which I have seen have the aperture without a definite neck, but in this variety the test is gradually prolonged into a long tapering neck.

LAGENA QUADRATA (Williamson).

Plate 14, fig. 9.

*Entosolenia marginata*, var. *quadrata* WILLIAMSON, Rec. Foram. Great Britain, 1858, p. 11, pl. 1, figs. 27, 28.

*Lagena lucida*, var. *quadrata* REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 324, pl. 2, fig. 26.

*Lagena quadrata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 475, pl. 59, figs. 3, 16.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 331, pl. 10, figs. 78, 79.—MILLETT, Journ. Roy. Micr. Soc., 1901, p. 496, pl. 8, fig. 18.—SIDEBOTTOM, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 50, No. 5, 1906, p. 8, pl. 1, figs. 21, 22; pl. 2, figs. 1–3.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 142.—SIDEBOTTOM, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 54, No. 16, 1910, p. 18, pl. 2, fig. 8 [?]; Journ. Quekett Micr. Club, vol. 11, 1912, p. 405, pl. 17, figs. 26–28 [?].

*Description.*—Test compressed, somewhat quadrate in outline, usually somewhat keeled, aperture somewhat elongate, wall smooth.

Length 0.5 mm.

*Distribution.*—Bagg records this species from *Albatross* stations H4440 in 1,259 fathoms and H4694 in 865 fathoms off the Hawaiian Islands. I have had the typical form only from *Nero* station 1208 in 665 fathoms between Guam and Yokohama.

LAGENA QUADRATA (Williamson), var. RIZZÆ (Seguenza).

Plate 19, fig. 4.

*Fissurina rizzæ* SEGUENZA, Foram. monotal. Mioc. Messina, 1862, p. 72, pl. 2, fig. 50.

*Lagena quadrata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 475, pl. 60, fig. 5.

*Description.*—Test subquadrate, compressed, central portion smooth, each side with a peripheral carina just back from the edge of the test, neck short, aperture with a broad phialine lip.

Length 0.5 mm.

*Distribution.*—This variety occurred at two *Nero* stations 1464 in 891 fathoms near Guam and 1310 in 518 fathoms between Guam and Japan.

This is close to the form figured by Brady in the *Challenger* report and seems near enough to the above form described by Seguenza to warrant the use of his name for it.

LAGENA QUADRICOSTULATA Reuss.

Plate 14, fig. 1.

*Lagena quadricostulata* REUSS, Sitz. Akad. Wiss. Wien, vol. 62, 1870, p. 469.—SCHLICHT, Foram. Pietzpuhl, 1870, pl. 4, figs. 25–30.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 486, pl. 59, figs. 7(?), 15.

*Description.*—"Test pyriform and more or less compressed, the margin obtuse or rounded, the base frequently mucronate, and the aperture entosolenian; the surface bears four arched costæ, two on each face of the test, near the lateral margins and parallel to them.

The costæ are thickest near the middle, and taper away toward the ends."

Length 0.25 mm.

*Distribution.*—In the volumes on the "Summary of Results of the *Challenger* Expedition" this species is recorded on page 965 from station 246 in 2,050 fathoms, and on page 937 recorded with a question from station 237. In many respects this is close to *L. fasciata* Egger.

LAGENA LUCIDA (Williamson).

*Entosolenia marginata*, var. *lucida* Williamson, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 17, pl. 2, fig. 17.

*Lagena lucida* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, 1862 (1863), p. 324, pl. 2, figs. 25, 26.—Balkwill and Millett, Journ. Micr., vol. 3, 1884, p. 80, pl. 2, fig. 7; pl. 3, figs. 4, 5.—Millett, Journ. Roy. Micr. Soc., 1901, p. 494.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 50, No. 5, 1906, p. 6, pl. 1, figs. 9–12; vol. 54, No. 16, 1910, p. 17, pl. 2, fig. 7; Journ. Quekett Micr. Club, vol. 11, 1912, p. 401, pl. 17, figs. 12–14.

*Description.*—Test somewhat compressed, marginal portion and central area clear and translucent, with a rather broad more or less opaque band between, wall smooth, aperture usually fissurine or rounded.

Length 0.3 to 0.8 mm.

*Distribution.*—At three North Pacific stations excellent specimens of this species were found, *Nero* station 1464 in 891 fathoms off Guam; 1129 in 1,505 fathoms southeast of Japan; and *Albatross* H4881 in 316 fathoms off Japan.

The specimens vary much in outline, one being very truncate and broad at the apertural end, others rounded.

LAGENA FASCIATA Egger, var. SPINOSA Sidebottom.

*Lagena fasciata* Egger, var. *spinosa* Sidebottom, Journ. Quekett Micr. Soc., vol. 11, 1912, p. 402, pl. 17, figs. 16, 17.

*Description.*—Test ovate, compressed, central portion ornamented by two bands on each side nearly meeting at the apertural and aboral ends; periphery with an apical and two lateral spines; aperture fissurine, made up of a linear series of small openings.

Length 0.5 mm.

*Distribution.*—Sidebottom described this variety from the South Pacific. The only station in the North Pacific from which I have material is *Albatross* D4972 in 440 fathoms, bottom temperature 39.8° F. off Japan.

This is similar to the specimen figured here as *L. staphyllearia*, but that lacks the characteristic ornamentation of *L. fasciata*.

LAGENA FASCIATA Egger, var. CARINATA Sidebottom.

Plate 21, fig. 1.

*Lagena fasciata* Egger, var. *carinata* Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 50, No. 5, 1906, p. 7, pl. 1, fig. 17; Journ. Quekett Micr. Club, vol. 11, 1912, p. 403, pl. 17, fig. 18.

*Description.*—Test more or less compressed, each side of the body portion with a curved band, usually hollowed somewhat into the surface of the test, the periphery of the test with a keel, surface otherwise smooth.

Length 0.35 to 0.85 mm.

*Distribution.*—This variety occurred at several *Nero* stations in the vicinity of the Hawaiian Islands at depths ranging from 22 to 2,098 fathoms; between Guam and Yokohama at several *Nero* stations ranging in depth from 1,417 to 1,817 fathoms; at two *Albatross* stations off Japan, D4825, in 120 fathoms, and H4878, in 84 fathoms, and two *Scarora* stations; 28 in lat. 35° 15′ N.; long. 120° 58′ W., in 65 fathoms, and 47 in lat. 24° 20′ N.; long. 154° 06′ E., in 1,499 fathoms.

LAGENA SEMINIFORMIS Schwager.

Plate 11, fig. 2.

*Lagena semini*—SCHWAGER, *Novara* Exped., Geol. Theil., vol. 2, 1866, p. 208, pl. 5, fig. 7.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 478, pl. 310, figs. 28–30.

*Lagena margi*—*a*, var. *seminiformis* MILLETT, Journ. Roy. Micr. Soc., 1901, p. 620, pl. 4, fig. 3.

*Description.*—Test circular or ovate in front view, with a comparatively long tubular neck, whole surrounded by a wide, thin peripheral keel, extended at each side of the base into long pointed projections; wall smooth.

Length up to 1.26 mm.

*Distribution.*—Brady records this species from a single North Pacific station, *Challenger*, 224 in 1,850 fathoms.

LAGENA MARGINATA (Walker and Boys).

Plate 22, figs. 1–7.

*Serpula* (*Lagena*) *marginata* WALKER and BOYS, Test. Min., 1784, p. 2, pl. 1, fig. 7.

*Vermiculum marginatum* MONTAGU, Test. Brit., 1803, p. 524.

*Entosolenia marginata* WILLIAMSON (part), Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 17, pl. 2, figs. 15–17.

*Lagena marginata* BROWN, Illus. Conch. Great Britain, 1827, pl. 1, figs. 30, 31.—REUSS, Sitz. Acad. Wiss. Wien, vol. 46, 1862 (1863), p. 322, pl. 2, figs. 22*a*, *b*, 23*a*, *b*.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 476, pl. 59, figs. 21–23.—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc., vol. 12, 1888, p. 222, pl. 44, figs. 27, 29, 30, 32.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 332, pl. 10, figs. 20, 66, 67, 96, 97.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, 1894, p. 81, pl. 13, fig. 748; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 52.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 307, pl. 54, fig. 2.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 141.—SIDEBOTTOM, Journ. Quekett Micr. Club, vol. 11, 1912, p. 405, pl. 17, figs. 29–31; pl. 18, figs. 1–3.

*Description.*—Test more or less compressed, rounded in front view, wall smooth, bordered by a peripheral keel of greater or less width, solid or with radiating tubuli, aperture usually fissurine.

Length 0.25 to 1.50 mm.

*Distribution.*—This species in its various modifications is common in the North Pacific. Goës records it from the eastern Pacific in 695 to 1,201 fathoms and Bagg from four *Albatross* stations in the vicinity of the Hawaiian Islands, D4017, D4174, H4430, and H4696, in 305, 735–865, 1,544, and 367 fathoms, respectively. I have seen specimens from *Nero* station 172 in 2,086 fathoms near the Midway Islands, *Albatross* H3007 in 323 fathoms near the Hawaiian Islands, from over 25 *Nero* stations between Guam and Yokohama at depths ranging from 518 to 2,250 fathoms, from three *Albatross* stations off Japan, D4843, D4875, and D4953, in 100, 59[illegible]nd 1,350 fathoms, respectively. It also occurred at two *Tusca*[illegible]862 *a* stations, 47 in lat. 24° 20′ N.; long. 154° 06′ E., in 1,499 fat[illegible]vol. [illegible]s, and 58 in lat. 26° 52′ N.; long. 142° 21′ E., in 814 fathoms. [illegible] Phi.

There is much variation in the comparative b[illegible]910, p. and the character of the keel and in the amount of compres[illegible]17, figs. [illegible] the test and in the size of various specimens.

[illegible]rinal
[illegible]oac
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LAGENA MARGINATA (Walker and Boys), var.

Plate 21, fig. 2.

*Description.*—Test with a thin peripheral keel, broadest toward the base and sides, slightly emarginate below and gradually decreasing in width toward the apertural end, where it ceases entirely, leaving the upper third of the test noncarinate.

Length 0.75 mm.

*Distribution.*—Found at three stations between Guam and Yokohama, *Nero* stations 1155 in 1,632 fathoms, 1299 in 1,817 fathoms, and 1300 in 1,529 fathoms.

This is somewhat different from typical *L. marginata.*

LAGENA MARGINATA (Walker and Boys), var.

Plate 21, fig. 3.

*Description.*—Test compressed, with a peripheral keel similar to the preceding, but inside it a band similar to *L. fasciata* next an opaque band and a clear center, as in *L. lucida.*

Length 0.85 mm.

*Distribution.*—Found at *Albatross* station H2766 off the Hawaiian Islands in 196 fathoms.

This is a rather peculiar form, uniting, as it does, the characters of *L. marginata, L. fasciata,* and *L. lucida.*

LAGENA LAGENOIDES (Williamson).

Plate 16, fig. 2.

*Entosolenia marginata* WALKER and BOYS, var. *lagenoides* WILLIAMSON, Rec. Foram. Great Britain, 1858, p. 11, pl. 1, figs. 25, 26.

*Lagena lagenoides* REUSS, Sitz. Akad. Wiss. Wien, vol. 46, 1862, p. 324, pl. 2, figs. 27, 28.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 479, pl. 60, figs. 6, 8, 9, 12.—MILLETT, Journ. Roy. Micr. Soc., 1901, p. 623, pl. 14, fig. 8.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 141.—SIDEBOTTOM, Journ. Quekett Micr. Club, vol. 11, 1912, p. 411, pl. 18, figs. 22–28.

*Description.*—Test flask-shaped, usually compressed, body oval or ovate, surrounded by a simple peripheral keel which has numerous radiating tubulations, neck usually comparatively short, in complete specimens usually joined with the peripheral keel.

Length 0.4 to 1 mm.

*Distribution.*—The single *Albatross* station, H4566, in 572 fathoms off the Hawaiian Islands, seems to be the only record for this species in the North Pacific. I have a single specimen, here figured, from *Nero* station 1310 in 518 fathoms, between Yokohama and Guam.

There are apparently various modifications of the tubulated keeled Lagenas and from the North Pacific material at least two which may be definitely distinguished. Therefore I have here restricted the use of the name to those specimens which have a peripheral keel, which in its unbroken condition extends entirely about the periphery of the test, is rather remotely tubulated, the neck usually seeming a portion of the keel, comparatively short, usually the keel not emarginate but entire.

LAGENA LAGENOIDES (Williamson), var. TENUISTRIATA H. B. Brady.

Plate 16, fig. 3.

*Lagena tubulifera* H. B. BRADY, var. *tenuistriata* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 61.

*Lagena lagenoides* WILLIAMSON, var. *tenuistriata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 479, pl. 60, fig. 11 (not 15, 16).—SIDEBOTTOM, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 50, No. 5, 1906, p. 12, pl. 2, figs. 9, 10; Journ. Quekett Micr. Club, vol. 11, 1912, p. 413, pl. 19, figs. 4, 5.

*Description.*—Test flask-shaped, pyriform, keel with comparatively few, large, remote tubulations; body of test not greatly compressed; surface ornamented with coarse longitudinal costæ running the length of the body of the test.

Length 0.35 to 0.50 mm.

*Distribution.*—This restricted varietal form has occurred at four stations in the *Nero* material at one station; 542 in 1,996 fathoms between Midway Islands and Guam and three stations; 1137 in 2,250 fathoms; 1160 in 1,907 fathoms, and 1287 in 1,606 fathoms between Guam and Yokohama.

In the *Challenger* report under this variety Brady figures what seem from a study of the North Pacific material to be two distinct forms. In plate 60, figure 11, is given a figure of a specimen which in its essential characters is very similar to the specimen figured here, plate 16, figure 3. On plate 60, figures 15, 16 are figured specimens with a very wide keel with numerous fine tubulations and the surface ornamented with very fine striations instead of costæ. I find in the North Pacific material that this distinction is met with in all the specimens examined, and I have included under Brady's var. *tenuistriata* such specimens as are figured here and selected by Side-bottom in his figures above referred to. The other form is placed under the following species.

LAGENA SUBLAGENOIDES, new species.

Plate 16, fig. 4.

*Lagena lagenoides* (part) H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 479, pl. 60, figs. 13, 14.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 223, pl. 44, fig. 23.—Millett, Journ. Roy. Micr. Soc., 1901, p. 623, pl. 14, fig. 9 [?]

*Description.*—Test flask-shaped, much compressed, central body of test elongate ovate tapering into a long, slender neck, surrounded by a wide peripheral keel with numerous close-set, fine tubulations, central portion smooth, apical end of keel usually but not always emarginate.

Length 0.60 to 0.85 mm.

*Distribution.*—This, like *L. formosa* Schwager, seems to be a deep-water species. It was found at three North Pacific stations; *Albatross* D2806 in 1,379 fathoms off the Galapagos Islands; *Nero* 170 in 1,990 fathoms and 173 in 2,111 fathoms near the Midway Islands. Type-specimen, Cat. No. 8540, U.S.N.M. from *Albatross* station D2806.

This seems to be a distinct species from the ordinary forms of *L. lagenoides* Williamson, distinguishable by its much broader keel, with numerous fine, closely set tubulations, and long, slender neck.

LAGENA SUBLAGENOIDES, new species, var. STRIATULA, new variety.

Plate 16, fig. 5.

*Lagena lagenoides* (Williamson), var. *tenuistriata* H. B. Brady (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 479, pl. 60, figs. 15, 16 (not fig. 11).

*Description.*—Variety distinguished from the typical form by the surface ornamentation of the body of the test, consisting of delicate, slightly irregular longitudinal striæ.

Length 1 mm.

*Distribution.*—Strangely enough this variety was not found at any of the stations where the typical form occurred. Type-specimen, Cat. No. 8541, U.S.N.M., from *Nero* station 1440 in 1,737 fathoms,

north of Guam. It also occurred at three other *Nero* stations; 1439 in 1,901 fathoms also north of Guam; 1691 in 1,912 fathoms between Guam and the Midway Islands, and 166 in 1,850 fathoms between the Midway and Hawaiian Islands.

This variety is characterized by very fine, often slightly wavy longitudinal striæ, a type of ornamentation which seems to go with the broad keel with fine tubulations.

### LAGENA FORMOSA Schwager.

Plate 11, fig. 6.

*Lagena formosa* Schwager (part), *Novara* Exped., Geol. Theil, vol. 2, 1886, p. 207, pl. 4, figs. 19*a*, 19*d* (not 19*b*, 19*c*).—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 480, pl. 60, figs. 10, 18–20.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 53.—Millett, Journ. Roy. Micr. Soc., 1901, p. 624, pl. 14, figs. 10–12.—Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 414, pl. 19, figs. 6–9.

*Lagena lagenoides* Egger (not Williamson), Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 335, pl. 10, fig. 85.

*Description.*—Test flask-shaped, compressed, body of test elongate oval, with a long, tapering, slender neck, the central portion of the test immediately surrounded on either side by a raised edge outside of which peripherally is a broad keel with radiating fine tubulations; apertural and apical ends of the central portion of the test passing into the inner keel by a series of interrupted costæ, apical end of peripheral keel usually emarginate.

Length up to 1 mm. or more.

*Distribution.*—Brady records this species from two *Challenger* stations in the North Pacific, in 1,850 and 2,575 fathoms. Goës records it from *Albatross* station 3399 in the eastern Pacific in 1,740 fathoms. I have found this species to be fairly common in the *Nero* material from the region between Guam and Yokohama, mostly in comparatively deep water, the depths varying from 1,417 to 2,119 fathoms. It occurred near Guam at *Nero* station 1464 in 891 fathoms; near the Midway Islands, *Nero* station 170 in 1,990 fathoms; station 91 in 1,983 fathoms and off the Hawaiian Islands, *Nero* station 10 in 2,098 fathoms.

This is a large and beautifully ornamented species. It seems to be widely distributed in deep water.

### LAGENA FORMOSA Schwager, var. FAVOSA H. B. Brady.

Plate 11, fig. 7.

*Lagena formosa* Schwager, var. *favosa* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 480, pl. 60, fig. 21.

*Description.*—Variety differing from the typical in having two or three rows of reticulate ornamentation between the body of the test and the peripheral wing.

Length 1 mm.

*Distribution.*—Described by Brady in the *Challenger* report from *Challenger* station 224 in 1,850 fathoms in the western part of the North Pacific.

LAGENA FORMOSA Schwager, var. COMATA H. B. Brady.

Plate 11, fig. 8.

*Lagena formosa* Schwager, var. *comata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 480, pl. 60, fig. 22.

*Description.*—Variety differing from the typical in having the body of the test striate and the periphery and base of the neck reticulate.

Length 0.85 mm.

*Distribution.*—This variety was described by Brady from *Challenger* station 224 in 1,850 fathoms in the western part of the North Pacific. The only North Pacific station from which I have seen this variety is *Nero* 1464 in 891 fathoms.

LAGENA BICARINATA Terquem, var. LATEROCOSTATA, new variety.

*Description.*—Test compressed, ovate in front view, periphery of test concave with a keel at either side, on each side of the body portion posteriorly a short, curved, prominent costa, remainder of body surface smooth.

Length 0.4 mm.

*Distribution.*—Type-specimen Cat. No. 8553, U.S.N.M., from *Nero* station 1012 in 1,932 fathoms north of Guam.

LAGENA ORBIGNYANA (Seguenza).

Plate 19, fig. 1.

*Entosolenia marginata* Williamson (part) (not *L. marginata* (Walker and Boys)), Rec. For. Great Britain, 1858, p. 9, pl. 1, figs. 19, 20.

*Fissurina orbignyana* Seguenza, Foram. monotal. Mioc. Messina, 1862, p. 66, pl. 2, figs. 24, 26.

*Lagena orbignyana* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 484, pl. 59, figs. 1, 18, 24, 26.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 222, pl. 44, fig. 20.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 333, pl. 10, figs. 89–91.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 308, pl. 54, fig. 4.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 50, No. 5, 1906, p. 12, pl. 2, fig. 11.

*Lagena orbignyana*, var. *elongata* Goës, Bull. Mus. Comp. Zool., vol. 29, 1896, p. 52.

*Description.*—Test rounded or elongate, ovate, much compressed, whole test surrounded by a peripheral keel inside of which on either side of the test is a complete raised rim about the body proper, neck somewhat elongate, wall smooth, in side view appearing tricarinate.

Length 0.5 to 0.7 mm.

*Distribution.*—Goës records the elongate form of this species from *Albatross* stations in the eastern Pacific in 1,132 to 1,201 fathoms. I have had specimens from *Nero* station 2049 in 2,226 fathoms off the Hawaiian Islands and from numerous stations between Guam and Yokohama, depths ranging from 688 to 1,907 fathoms. It also occurred at two *Albatross* stations off Japan, D4957 in 437 fathoms and D4975 in 712 fathoms.

The elongate form here figured has occurred much more frequently than the rounded form.

LAGENA ORBIGNYANA (Seguenza), var. LACUNATA (Burrows and Holland).

Plate 20, fig. 1.

*Lagena castrensis* H. B. Brady (not Schwager), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 485, pl. 60, figs. 1, 2.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28 (Sci.), 1885, p. 341, pl. 12, figs. 20, 21.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 333, pl. 10, figs. 71, 72.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 308, pl. 54, fig. 5.

*Lagena lacunata* Burrows and Holland, in Jones, Palaeont. Soc., 1895, p. 205, pl. 7, fig. 12.

*Lagena orbignyana*, var. *castrensis* Millett, Journ. Roy. Micr. Soc., 1901, p. 626, pl. 14, fig. 20.

*Lagena orbignyana*, var. *lacunata* Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 54, No. 16, 1910, p. 19, pl. 2, fig. 14; Journ. Quekett Micr. Club, vol. 11, 1912, p. 416, pl. 19, figs. 16–18.

*Description.*—Variety with the body portion of the test marked by a network of lacunæ or pitted areas of varying size, usually darker in color than the rest of the test.

Length 0.35 mm.

*Distribution.*—Brady records this variety from the *Challenger* station south of Japan on the *Hyalonema*-ground, depth 345 fathoms. I have had material from three *Nero* stations between Guam and Yokohama, 1154 in 1,602 fathoms, 1300 in 1,529 fathoms, and 1310 in 518 fathoms. It also occurred at two *Albatross* stations off Japan, D4875 in 59 fathoms and D4966 in 290 fathoms, and at *Tuscarora* station 23, lat. 21° 40′ N.; long. 179° 20′ E., in 1,964 fathoms.

Schwager's figure and description call for a specimen with its ornamentation made up of raised beads on the body portion of the test. It seems that a distinction should be made between the raised beads and pitlike lacunæ.

LAGENA ORBIGNYANA (Seguenza), var. CORONATA Sidebottom.

Plate 20, fig. 3.

*Lagena orbignyana* (Seguenza), var. *coronata* Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 416, pl. 19, fig. 15.

*Description.*—Variety with the central area translucent, surrounded by an opaque band, outside of which is the inner keel,

peripherally bordered by the wider median keel, which is denticulate about the basal half of the border.

Length of North Pacific specimens 1 mm.

*Distribution.*—Found in the North Pacific material only at *Albatross* station H2902 in 1,783 fathoms near the Hawaiian Islands.

This seems to agree nearly enough with the above variety to warrant its being placed here. The opaque ring is here decidedly raised and annular but the other characters are very similar.

LAGENA ORBIGNYANA (Seguenza), var. CONCENTRICA Sidebottom.

Plate 19, fig. 2.

*Lagena orbignyana* (Seguenza), var. *concentrica* Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 417, pl. 19, fig. 23.

*Description.*—Test compressed, but umbonate, median keel well developed, inner keel less prominent; body portion ornamented by concentric costæ, apertural end bluntly pointed.

Length 0.6 mm.

*Distribution.*—Figured specimen from *Nero* station 1464 in 891 fathoms off Guam.

Although more umbonate than shown in the figure referred to above, this specimen has all the essential characters of this variety.

LAGENA ORBIGNYANA (Seguenza), var. CLATHRATA H. B. Brady.

Plate 11, fig. 4.

*Lagena clathrata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 484, pl. 60, fig. 4.—Balkwill and Millett, Journ. Micr., vol. 3, 1884, p. 82, pl. 2, fig. 14; pl. 4, fig. 3.

*Lagena orbignyana*, var. *clathrata* Millett, Journ. Roy. Micr. Soc., 1901, p. 628, pl. 14, fig. 23.—Sidebottom, Journ. Quekett Micr. Club, vol. 11, 1912, p. 418.

*Description.*—Variety with the central portion of the test ornamented with longitudinal costæ.

Length 0.25 mm.

*Distribution.*—This variety occurred at two *Nero* stations, 1294 in 1,417 fathoms and 1448 in 2,084 fathoms between Guam and Yokohama.

Our specimens are not typical of the variety, as they are much more finely costate than is Brady's figure of this variety.

LAGENA ORBIGNYANA (Seguenza), var. CRENULATA, new variety.

Plate 20, fig. 2.

*Description.*—Variety with the central portion of the test ornamented by very slightly developed, irregular striæ, the border regularly pitted, inner keel normal, outer keel broad, the surface

between the two keels regularly crenulated, apertural end with a short broad neck, truncate.

Length 0.35 mm.

*Distribution.*—Type-specimen, Cat. No. 8542, U.S.N.M., from *Albatross* station H4878 in 84 fathoms off Japan. It also occurred at *Albatross* station D4957 in 437 fathoms; also off Japan and *Nero* station 1464 in 891 fathoms off Guam.

This variety seems rather distinctive.

LAGENA ORBIGNYANA (Seguenza), var. ALATA, new variety.

Plate 23, fig. 1.

*Description.*—Variety with the central portion smooth, except at the border, where it is regularly pitted, peripheral keel extended outward into a very broad, thin keel extending about the entire test from the aperture, radiately striate, basal border tending to become denticulate.

Length 0.45 mm.

*Distribution.*—Type-specimen, Cat. No. 8543, U.S.N.M., from *Albatross* station D4953 in 1,350 fathoms off Japan.

This seems to be different from any of the previously described varieties of this species.

LAGENA FAVOSO-PUNCTATA H. B. Brady.

Plate 11, fig. 5.

*Lagena favoso-punctata* H. B. Brady, Quart. Journ. Micr. Soc., vol. 21, 1881, p. 62; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 473, pl. 58, fig. 35; pl. 59, fig. 4; pl. 61, fig. 2.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 325, pl. 10, fig. 98.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 140.

*Description.*—Test ecto- or entosolenian, shape variable; surface areolated or reticulated, with a conspicuous orifice or perforation in the middle of each area or depression.

Length 0.34 mm. or less.

*Distribution.*—The only North Pacific records for this species are those given by Bagg, H4590 in 978 fathoms and H4694 in 865 fathoms off the Hawaiian Islands.

LAGENA TRIGONO-MARGINATA Parker and Jones

Plate 14, figs. 3, 4.

*Lagena trigono-marginata* Parker and Jones, Philos. Trans., vol. 155, 1865, p. 348, pl. 18, figs. 1*a*, *b*.—Wright, Proc. Belfast Nat. Field Club, 1876–77, App., p. 104, pl. 4, figs. 8*a*, *b*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 482, pl. 61, figs. 12, 13.

*Description.*—Test ovate or pyriform, trifacial, the angles of the test ornamented by a marginal beading with an acute edge often

subcarinate, or smooth and without the beading, occasionally rounded and not distinctly carinate, aperture rounded.

Length 0.35 mm.

*Distribution.*—Brady records this species from one North Pacific *Challenger* station, 241 in 2,300 fathoms.

This has by some authors been referred to *L. orbignyana* as a variety.

### Subfamily 2. NODOSARIINÆ.

Test polythalamous; chambers arranged in a straight, arcuate, planospiral or uncoiling series, apertures either radiate or with a neck and phialine lip.

### Genus NODOSARIA Lamarck, 1812.

*Nodosaria* Lamarck (type, *N. raphanistrum* (Linnæus), (Extrait Cours Zool., 1812, p. 121; Hist. Anim. Sans Vert., vol. 7, 1822, p. 596.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 488.

*Description.*—Test composed of a straight or arcuate series of chambers, either loosely joined together by stolons or close-set and overlapping or various forms between; surface smooth or ornamented; aperture either radiate or with a definite neck and phialine lip.

In this genus both microspheric and megalospheric forms occur. In some species the megalospheric proloculum is the largest chamber of the series and none of the following chambers attain so large a diameter. In the microspheric form the proloculum is very small and the chambers gradually increase in size.

Some species tend to show definite senescent characters in the loss of the ornamentation in the later developed chambers. In some cases also the last formed chamber tends to become separated from the preceding ones by a constriction of the connection between them and a *Lagena*-like last chamber results.

In some species the ornamentation extends back to the proloculum which assumes the characteristic costæ, etc., of adult chambers.

In the subgenus *Glandulina* there is a tendency for the chambers to reach back and overlap the preceding ones, often making the sutures hardly visible, with little or no depression.

In *Dentalina* there is a tendency toward an arcuate form with the sutures coincidently oblique instead of directly transverse. Such conditions tend toward the theory that these may in reality be uncoiled forms which have in the megalospheric form at least lost their early coiled stages. The microspheric form in rare cases shows a tendency of the early chambers to be coiled in these arcuate and oblique sutured forms.

It is possible that *Glandiolus* Montfort, 1808, may have to replace *Nodosaria* Lamarck, 1812, if an examination of Montfort's types

shows that the two are synonymous. At present Montfort's poorly executed figures make it impossible to determine his species with certainty without such an examination of types, and at present this is impossible.

#### NODOSARIA (GLANDULINA) ROTUNDATA (Reuss).

Plate 28, fig. 6.

*Glandulina rotundata* Reuss, Denkschr. Akad. Wiss. Wien, vol. 1, 1849, p. 366, pl. 46, fig. 2.

*Nodosaria* (*Glandulina*) *rotundata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 491, pl. 61, figs. 17–19.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 308, pl. 54, fig. 6.—Millett, Journ. Roy. Micr. Soc., 1902, p. 510.

*Description.*—Test oval or subovate, broadest in the middle, composed of few chambers, apical end broadly rounded, without spines, apertural end more elongate, aperture with radiate lines about the margin; last-formed chamber occupying one-half or more of the visible test.

Length 1 to 2 mm.

*Distribution.*—This species has not previously been recorded from the North Pacific. I have found it at *Albatross* station D4807, off Japan, in 44 fathoms.

Millett raises the question as to whether this and *N. laevigata* are microspheric and megalospheric forms of a single species.

In the figured specimen the last-formed chamber occupies rather more than usual of the surface of the test.

#### NODOSARIA (GLANDULINA) LAEVIGATA d'Orbigny.

Plate 24, figs. 1, 2.

"Cornu Hammonis erectum globosius" Plancus, Conch. Min., 1739, p. 16, pl. 13, fig. 1.

*Nodosaria* (*Glandulina*) *laevigata* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 252, pl. 10, figs. 1–3.—Parker and Jones, Philos. Trans., vol. 155, 1865, p. 340, pl. 13, fig. 1.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 490, pl. 61, figs. 20–22.—Burrows, Sherborn, and Bailey, Journ. Micr. Soc., 1890, p. 556, pl. 19, figs. 14, 15.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 71, pl. 13, figs. 702, 703, 705, 707, 709; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 59.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 308, pl. 55, fig. 3.—Millett, Journ. Roy. Micr. Soc., p. 509, pl. 11, fig. 1.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 143.

*Glandulina laevigata* d'Orbigny, For. Foss. Bass. Tert. Vienne, 1846, p. 29, pl. 1, figs. 4, 5.—Bornemann, Zeitschr. deutsch. Geol. Gess., vol. 7, 1855, p. 320, pl. 12, fig. 8.—Neugeboren, Denkschr. Akad. Wiss. Wien, vol. 12, 1856, p. 67, pl. 1, figs. 3, 4.—Haeusler, Neues Jahrb. für Min., 1887, p. 189, pl. 5, fig. 29.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 336, 339, pl. 11, fig. 31.—Silvestri, Mem. Pont. Accad. Nuovi Lincei, vol. 17, 1900, p. 248, pl. 6, figs. 41, 49.

*Description.*—Test fusiform, very broad in the middle, tapering rapidly toward either end; apical end usually with one or more spines;

chambers few, embracing, the last-formed one making up two-thirds or more of the visible test, sutures flush but marked by a distinct fine line; apical end somewhat rounded, usually with radiate lines about the aperture; wall smooth.

Length 2 mm. or more.

*Distribution.*—Brady records this species from the North Pacific in 7–95 fathoms. The latter depth represents the *Challenger* station off the Philippines. Goës records it at four *Albatross* stations in the eastern Pacific, D3371 in 770 fathoms, D3375 in 1,201 fathoms, D3376 in 1,132 fathoms, and D3407 in 885 fathoms. Bagg records it from three stations off the Hawaiian Islands, *Albatross* D4025 in 275–368 fathoms, H4555 in 1,398 fathoms, and H4696 in 367 fathoms. I have had material from the western portion of the region, *Albatross* D4843, off the coast of Korea in 100 fathoms, bottom temperature 39.9° F.

### NODOSARIA CALOMORPHA Reuss.

Plate 25, fig. 6.

*Nodosaria calomorpha* Reuss, Denkschr. Akad. Wiss. Wien, vol. 25, 1865, p. 129, pl. 1, figs. 15–19.—Terrigi, Atti Accad. Pont., ann. 33, 1880, p. 178, pl. 1, fig. 7.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 497, pl. 61, figs. 23–27.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 223, pl. 44, figs. 1, 4?—Burrows, Sherborn, and Bailey, Journ. Roy. Micr. Soc., 1890, p. 566, pl. 9, fig. 21.—Terrigi, Mem. Com. Geol. Italia, vol. 4, 1891, p. 78, pl. 2, fig. 5.—Chaster, First Rep. Southport Soc. Nat. Sci., 1890–1891 (1892), p. 63, pl. 1, fig. 12.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 340, pl. 11, figs. 21, 26.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 72, pl. 13, figs. 712, 713.—Morton, Proc. Portland Soc. Nat. Hist., vol. 2, 1897, p. 118, pl. 1, fig. 6.—Millett, Journ. Roy. Micr. Soc., 1902, p. 513.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 51, No. 9, 1907, p. 1, pl. 1, figs. 1–8.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 142.

*Description.*—Test elongate, usually somewhat arcuate, composed of a few elliptical chambers in adult specimens three to five in number; wall smooth or occasionally with a few very delicate hispid spines, wall transparent; both ends broadly rounded, smooth; aperture a simple opening without neck.

Length 0.50–1.00 mm.

*Distribution.*—Brady records this species in the North Pacific at a single *Challenger* station off the Philippines in 95 fathoms. Bagg records it at a single *Albatross* station, H4508, in 495 fathoms off the Hawaiian Islands. I have a single specimen here figured, plate 25, figure 6, from *Nero* station 1313, in 1,716 fathoms, between Guam and Japan.

This seems in all its characters to be a primitive species and one with little character except the form, the few chambers, and the transparent wall of the test. These elementary characters, however, seem to be rather constant.

### NODOSARIA SIMPLEX Silvestri.

Plate 28, fig. 5.

*Nodosaria simplex* Silvestri, Atti Accad. Gioenia, Catania, ser. 3, vol. 7, 1872, p. 95, pl. 11, figs. 268–272.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 496, pl. 62, figs. 4, 5, and 6?—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 340, pl. 11, fig. 6.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 309, pl. 55, fig. 2.

*Description.*—Test composed of two or more chambers, the initial chamber globular with a short spine at the base, the second pyriform with a well drawn out neck and radiate aperture; wall smooth, sutures well depressed.

Length about 1 mm.

*Distribution.*—There are no previously published records for this species in the North Pacific. The only record I have is *Albatross* D2806 off the Galapagos Islands in 1,379 fathoms. The specimen obtained here is very typical, like Silvestri's figures and like fig. 4 of the *Challenger* report.

### NODOSARIA PYRULA d'Orbigny.

Plate 26, figs. 1–3.

Orthoceras Monile" Soldani, Testaceographia, vol. 2, 1798, p. 35, pl. 10, figs. *b*, *c*.

*Nodosaria pyrula* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 253, No. 13.—Williamson, Rec. Foram. Great Britain, 1858, p. 17, pl. 2, fig. 39.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 497, pl. 62, figs, 10–12.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28, 1885, p. 343, pl. 12, fig. 23.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 223, pl. 44, fig. 2.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 345, pl. 11, figs. 14, 15.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 309, pl. 55, fig. 4.—Millett, Journ. Roy. Micr. Soc., 1902, p. 514.

*Description.*—Test elongate, very slender, composed of numerous chambers, either in a straight or slightly curved line, pyriform in shape with long tapering necks; surface smooth, chambers varying little in size; proloculum extended backward in a long drawn out point.

Length up to 8 mm.

*Distribution.*—Brady records this species at two *Challenger* stations, 95 fathoms off the Philippines and the *Hyalonema*-grounds off Japan, 345 fathoms. Goës had specimens which he records under *N. monile* from two *Albatross* stations, D3375 in 1,201 fathoms and D3431 in 995 fathoms, in the eastern Pacific. I have seen only broken specimens in the material examined from *Albatross* station D4891, off Japan, 181 fathoms, bottom temperature 50.2° F., and D4807, off Japan, in 44 fathoms.

Specimens are rarely obtained in an entire condition due to the delicacy of the connecting stolonlike necks. It is a species of comparatively shallow and comparatively warm water from the records available.

#### NODOSARIA PYRULA d'Orbigny, var. SEMIRUGOSA d'Orbigny.

Plate 26, figs. 4–8.

*Nodosaria semirugosa* d'Orbigny, Foram. Foss. Bass. Tert. Vienne, 1846, p. 34, pl. 1, figs. 20–23.—Millett, Journ. Roy. Micr. Soc., 1902, p. 515, pl. 11, fig. 5.

*Nodosaria* No. 35, von Schlicht, Foram. Septarien Thones von Pietzpuhl, 1870, p. 24, pl. 7, fig. 20.

*Nodosaria stipitata* Reuss, var. *costulata* Reuss, Sitz. Akad. Wiss. Wien, vol. 62, Abth. 1, 1870, p. 471.

*Nodosaria costulata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 515, pl. 63, figs. 23–27.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 312, pl. 58, fig. 1.

*Description.*—Similar to typical *Nodosaria pyrula*, but with the basal portion of each chamber with several costæ and alternating depressions.

*Distribution.*—Brady records this species at the *Challenger* station off the Philippines in 95 fathoms. I have it from *Albatross* D4807 in 44 fathoms off Japan. From material examined it seems that this is but a variable form of *N. pyrula* and frequently occurs with it in tropical and subtropical waters. Millett is certainly right in referring this form to *N. semirugosa* d'Orbigny.

#### NODOSARIA GUTTIFERA (d'Orbigny).

Plate 35, fig. 5.

*Dentalina guttifera* d'Orbigny, For. Foss. Bass. Tert. Vienne, 1846, p. 49, pl. 2, figs. 11–13.—H. B. Brady, Ann. Mag. Nat. Hist., ser. 4, vol. 6, 1870, p. 296, pl. 12, fig. 2.

*Nodosaria guttifera* Steinmann, Elem. Palæont., vol. 1, 1888, p. 27, fig. 8. B.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 143.

*Description.*—Test composed of a few chambers, each pyriform in shape connected by stolonlike tubes, broadly rounded at base, thence tapering gradually to the apertural end, wall smooth.

Length 2.5 mm.

*Distribution.*—Bagg refers to this species fragments of *Nodosaria* found at *Albatross* station H4566 in 572 fathoms off the Hawaiian Islands. One of these is here figured.

Of d'Orbigny's figures in the Vienna Basin Monograph, figure 11 seems certainly to be referable to *N. pyrula* d'Orbigny, but figure 13 is much more like the specimens found by Bagg. It is not like the ordinary form or size of *N. pyrula*.

### NODOSARIA PAUPERATA (d'Orbigny).

Plate 25, fig. 7.

*Dentalina pauperata* d'Orbigny, For. Foss. Bass. Tert. Vienne, 1846, p. 46, pl. 1, figs. 57, 58.—Bornemann, Zeitschr. deutsch. geol. Ges., vol. 7, 1855, p. 324, pl. 13, fig. 7.—H. B. Brady, Proc. Somerset Arch. and Nat. Hist. Soc., vol. 13, 1867, p. 108, pl. 1, fig. 14.

*Nodosaria pauperata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 500, woodcuts figs. 14*a*, *b*, *c*.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 68, pl. 12, figs. 682–688 [part]; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 61.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 144.

*Description.*—Test comparatively short, slightly arched, tapering, composed of a few chambers, cylindrical in the early portion, later chambers more inflated; apical end usually with a short spine; apertural end slightly prolonged.

Length 2 mm.

*Distribution.*—Goës records rather poor examples of this species from three *Albatross* stations in the eastern Pacific, D3363 in 978 fathoms, D3376 in 1,132 fathoms, and D3399 in 1,740 fathoms. Bagg records it from the vicinity of the Hawaiian Islands at two *Albatross* stations, D4000 in 104–213 fathoms and D4025 in 275–368 fathoms. These specimens also are not typical, one broken one being here figured. It is not mucronate and the apertural portion is broken away.

### NODOSARIA ABYSSORUM H. B. Brady.

Plate 28, fig. 7.

*Nodosaria* (?) *abyssorum* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 63; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 504, pl. 63, figs. 8, 9.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 342, pl. 11, fig. 11 [?].

*Description.*—Test elongate, composed of several chambers, straight or slightly arcuate, chambers inflated, subspherical, sutures much depressed, surface smooth, apical end broadly rounded, with a group of short acicular spines; aperture at the end of a short neck, with a phialine lip.

Length up to 4 mm.

*Distribution.*—This species has not previously been recorded in the North Pacific. I have it from two stations, *Nero* 1302 in 1,331 fathoms and 1867 in 2,311 fathoms in the western Pacific. The figured specimen from the first station is evidently broken, showing but the two early chambers. The specimen from the second station is also broken, but composed of eight chambers, and except for the larger number of chambers and broken lip is very similar to Brady's figures in the *Challenger* report.

This seems to be a rare, deep-water species.

NODOSARIA PROXIMA Silvestri.

*Nodosaria proxima* Silvestri, Atti Accad. Gioenia, Catania, ser. 3, vol. 7, 1872, p. 63, pl. 6, figs. 138–147.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 511, pl. 64, fig. 15.—Fornasini, Mem. Accad. Sci. Bologna, ser. 5, vol. 4, 1894, p. 206, pl. 1, figs. 33–35.—Millet, Journ. Roy. Micr. Sci., 1902, p. 519, pl. 11, fig. 9.

*Description.*—Test composed of few chambers, usually two, with several costæ, apical end often spinose; aperture at the end of a tubular neck.

Length 1 mm.

*Distribution.*—Brady records this species from two North Pacific stations, off the Philippines in 95 fathoms and from the coral reefs of Honolulu, Sandwich Islands, in 40 fathoms. I have seen no material which can not be referred to other species as young specimens.

NODOSARIA RADICULA (Linnæus).

"Cornu Hammonis erectum" Plancus, Conch. Min., 1739, p. 14, pl. 1, fig. 5.

*Nautilus radicula* Linnæus, Syst. Nat., ed. 12, 1767, p. 1164, 285; (Gmelin's) ed. 13, 1788, vol. 1, pt. 6, p. 3373, No. 18.—Montagu, Test. Brit., 1803, p. 197, pl. 6, fig. 4.

*Nodosaria radicula* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 252, No. 3; Modèles, No. 1.—H. B. Brady, Proc. Somerset Arch. and Nat. Hist. Soc., vol. 13, 1867, p. 106, pl. 1, fig. 4; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 495, pl. 61, figs. 28–31.—Sherborn and Chapman, Journ. Roy. Micr. Soc., 1886, p. 746, pl. 14, fig. 24.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 60.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 309, pl. 55, fig. 1.—Millett, Journ. Roy. Micr. Soc., 1902, p. 513.

*Description.*—Test elongate, composed of three or four chambers, with but slightly depressed sutures, wall smooth, apical end with a short spine; aperture at the end of a slightly produced neck.

Length about 2 mm.

*Distribution.*—Goës records this species from one *Albatross* station in the eastern Pacific, D3375 in 1,201 fathoms. I have had specimens from *Albatross* station H2999 in 549 fathoms, off the Hawaiian Islands, and from two *Nero* stations 1463 in 951 fathoms and 990 in 859 fathoms, both off Guam.

NODOSARIA INFLEXA Reuss.

Plate 25, fig. 1.

*Nodosaria inflexa* Reuss, Denkschr. Akad. Wiss. Wien, vol. 25, 1866, p. 131, pl. 2, fig. 1; Sitz. Akad. Wiss. Wien, vol. 62, 1870, p. 472, No. 16.—von Schlicht, For. Septarien Thones von Pietzpuhl, 1870, pl. 38, fig. 3.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 498, pl. 62, fig. 9.

*Description.*—Test elongate, tapering, slightly arcuate, chambers comparatively few, pyriform, united to one another with slight necks; wall smooth, portion of each chamber near the distal end clear, giving a darker appearance to that portion of the chamber.

Length 2 mm. or more.

*Distribution.*—Brady records this species at the *Challenger* station off the Philippines in 95 fathoms. I have had material from three stations, *Tuscarora* 2, lat. 21° 07′ N., long. 158° 14′ W., in 1,468 fathoms, and *Albatross* D4843 in 100 fathoms and D4979 in 943 fathoms. The bottom temperatures at these two stations were 39.9° and 36.4° F., respectively.

In some ways this species is intermediate between *N. pyrula* and *N. soluta*, and may be only a variety of the former. The peculiar dark appearance of the clear portions is rather distinctive.

#### NODOSARIA SOLUTA (Reuss).

Plate 26, figs. 9–11.

*Dentalina soluta* Reuss, Zeitschr. deutsch. geol. Ges., vol. 3, 1851, p. 60, pl. 3, figs. 4*a*, *b*.—Stache, *Novara* Exped., Geol. Theil, vol. 1, 1864, p. 203, pl. 22, fig. 29.—Hantken, Mitth. Jahrb. Ung. Geol. Anstalt., vol. 4, 1875, p. 29, pl. 2, figs. 2, 14.

*Nodosaria soluta* Bornemann, Zeitschr. deutsch. geol. Ges., vol. 7, 1855, p. 322, pl. 12, fig. 12.—Reuss, Denkschr. Akad. Wiss. Wien, vol. 25, 1865, p. 131, pl. 2, figs. 4–8.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 503, pl. 62, figs. 13–16; pl. 64, fig. 28.—Sherborn and Chapman, Journ. Roy. Micr. Soc., 1886, p. 746, pl. 14, figs. 25, 26.—Burrows, Sherborn, and Bailey, Journ. Roy. Micr. Soc., 1890, p. 557, pl. 9, fig. 26.—Chapman, Journ. Roy. Micr. Soc., 1893, p. 587, pl. 8, fig. 26.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 70, pl. 12, fig. 690; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 62.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 310, pl. 56, fig. 3.—Millett, Journ. Roy. Micr. Soc., 1902, p. 516.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 144.

*Description.*—Test elongate, somewhat arcuate, comparatively stout, composed of rather few globular or ovate chambers, inflated, sutures much depressed, aperture radiate with an acute neck, apical end often with a short spine; wall of the distal portion of the chamber smooth, the proximal half of each chamber usually roughened, often conspicuously so, sometimes faintly striate; color chalky white, opaque.

Length up to 6 mm. or more.

*Distribution.*—Goës recorded this species from the eastern Pacific at three *Albatross* stations, D3375, in 1,201 fathoms; D3376, in 1,132 fathoms; and D3407, in 885 fathoms. Flint records it from *Albatross* station, D2805, in 51 fathoms, Panama Bay, and Bagg from one *Albatross* station, H4964, in 865 fathoms, off the Hawaiian Islands. The only stations from which I have had material are, *Nero* 1298, in 1,711 fathoms, off Japan, and *Albatross* D4957, in 437 fathoms, also off Japan.

NODOSARIA HAUERIANA Neugeboren.

Plate 25, fig. 4.

*Nodosaria haueriana* NEUGEBOREN, Verh. Mitth. sieb. Ver. Nat., vol. 3, 1852, p. 39, pl. 1, figs. 8, 9.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 341, pl. 11, figs. 1, 25.

*Description.*—Test elongate, tapering, composed of few chambers, elongate pyriform, sutures much depressed, wall smooth, apertural end of last formed chamber very tapering.

Length about 1.50 mm.

*Distribution.*—Egger records this species off West Australia. The specimen here figured is from *Albatross* station D4966, off Japan, in 290 fathoms, bottom temperature 44.1° F.

NODOSARIA COMMUNIS d'Orbigny.

Plate 28, figs. 1, 2.

*Nodosaria* (*Dentalina*) *communis* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 254, No. 35.

*Dentalina communis* D'ORBIGNY, Mém. Soc. Géol. France, vol. 4, 1840, p. 13, pl. 1, fig. 4.

*Nodosaria communis* REUSS, Verst. Böhm. Kreid., pt. 1, 1845, p. 28, pl. 12, fig. 21.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 504, pl. 62, figs. 19–22.—BURROWS, SHERBORN, and BAILEY, Journ. Roy. Micr. Soc., 1890, p. 557, pl. 9, fig. 27.—CHAPMAN, Journ. Roy. Micr. Soc., 1893, p. 590, pl. 9, fig. 1.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 342, pl. 11, figs. 22–24.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 67, pl. 12, figs. 667–671; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 61, pl. 6, fig. 1.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 310, pl. 56, fig. 2.—MILLETT, Journ. Roy. Micr. Soc., 1902, p. 522.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 142.

*Description.*—Test elongate, slender, tapering, straight or more often slightly curved, composed of numerous chambers, slightly inflated toward the apical end but later ones becoming more inflated; sutures oblique; aperture radiate somewhat eccentric, elongate somewhat; surface smooth.

Length up to 3 mm. or more.

*Distribution.*—Goës records this species at three stations in the eastern Pacific, *Albatross*, D3376, in 1,132 fathoms; D3400, in 1,322 fathoms; and H2627, in 1,839 fathoms. Bagg records it from the vicinity of the Hawaiian Islands, D4000, in 104–213 fathoms; D4025, in 275–368 fathoms; H4430, in 1,544 fathoms; and H4566, in 572 fathoms. I have had material from numerous stations well scattered over the region between San Francisco and Hawaii, near Guam, several stations between Guam and Yokohama, and several stations off the coast of Japan. The shallowest depth is 124 fathoms and the deepest 2,615 fathoms.

Many very different forms have often been included in this species, and it may be questioned whether Brady was really correct in placing our recent material with d'Orbigny's Cretacean species.

### NODOSARIA FILIFORMIS d'Orbigny.

Plate 27, figs. 1–4.

"Orthoceratia filiformia aut capillaria" SOLDANI, Testaceographia, vol. 2, 1798, p. 35, pl. 10, fig. *e*.

*Nodosaria filiformis* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 253, No. 14.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 500, pl. 63, figs. 3–5.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 310, pl. 55, fig. 6.—MILLETT, Journ. Roy. Micr. Soc., 1902, p. 523.

*Dentalina filiformis* PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 4, vol. 8, 1871, p. 156, pl. 9, fig. 48.

*Description.*—Test elongate, slender, arcuate, chambers numerous, elliptical or ovate, elongate, tumid, sutures usually oblique, chambers increasing in length toward the apertural end, aperture radiate, slightly eccentric; wall smooth.

Length up to 5 mm.

*Distribution.*—Brady in the *Challenger* report mentions this species as being found in the North Pacific, but stations are not given. I have had material from the following stations: *Albatross* D3608 in 276 fathoms; material from stomachs of holothurians, D4900, in 139 fathoms off Japan; *Nero* station 1466, near Guam, in 234 fathoms; and *Tuscarora* station 11, in 437 fathoms, lat. 33° 46′ N.; long. 140° 21′ E.

Specimens are easily broken and complete specimens seem to be rare.

### NODOSARIA ROEMERI (Neugeboren).

Plate 24, figs. 4–6.

*Dentalina roemeri* NEUGEBOREN, Denkschr. Akad. Wiss. Wien, vol. 12, 1856, p. 82, pl. 2, figs. 13–17.

*Nodosaria roemeri* REUSS, Sitz. Akad. Wiss. Wien, vol, 62, 1870, p. 475.—VON SCHLICHT, Foram. Septarien Thones von Pietzpuhl, 1870, pl. 10, figs. 21, 22, 24.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 505, pl. 63, fig. 1.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 310, pl. 56, fig. 5.

*Description.*—Test elongate, somewhat arcuate, comparatively stout, composed of few chambers, early ones with little inflation, later ones somewhat inflated, apical end rounded, sutures oblique, wall smooth.

Length up to 4.5 mm.

*Distribution.*—Bagg records this species from one *Albatross* station off the Hawaiian Islands, H4566, in 572 fathoms. I have had material from three *Nero* stations, 10, near the Hawaiian Islands, in 2,098 fathoms; 201, near Midway Islands, in 1,033 fathoms; and 990, near Guam, in 859 fathoms.

The species is not well distinguished from *N. communis* and seems to be intermediate between this and *N. mucronata*.

NODOSARIA CONSOBRINA (d'Orbigny), var. EMACIATA (Reuss).

Plate 27, fig. 9.

*Dentalina emaciata* Reuss, Zeitschr. deutsch. geol. Ges., vol. 3, 1851, p. 63, pl. 3, fig. 9.

*Nodosaria* (*D.*) *consobrina*, var. *emaciata* Reuss, Denkschr. Akad. Wiss. Wien, vol. 25, 1865, p. 132, pl. 2, figs. 12, 13.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 502, pl. 62, figs. 25, 26.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 310, pl. 56, fig. 1.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 143.

*Description.*—Test elongate, tapering, slightly curved, composed of numerous chambers, short and cylindrical in form, sutures but slightly depressed in the early portion, later chambers more tumid and sutures somewhat depressed; wall smooth, apical and rounded.

Length up to 8 mm.

*Distribution.*—Bagg records this form from *Albatross* station D4000 in 104–213 fathoms off the Hawaiian Islands. I have had material from the same region at *Albatross* station H2922 in 268 fathoms, bottom temperature, 44.8° F.; H2986 in 271 fathoms; and *Nero* station 2071 in 271 fathoms. It occurred at *Nero* station 1464 in 891 fathoms, off Guam; and *Albatross* stations H4882 in 248 fathoms, off southern Japan, bottom temperature, 48.8° F., and D4965, also off Japan, in 191 fathoms, bottom temperature, 49.4° F.

NODOSARIA MUCRONATA (Neugeboren).

Plate 24, fig. 3; plate 25, fig. 2; plate 27, figs. 5–7; plate 35, fig. 6.

"Orthoceras intortum" Soldani, Testaceographia, vol. 1, pt. 2, 1791, p. 98, pl. 105, fig. V.

*Nodosaria* (*Dentalina*) *obliqua* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 254, No. 36; Modèles No. 5 (not *N. obliqua* (Linnæus)).

*Dentalina mucronata* Neugeboren, Denkschr. Akad. Wiss. Wien, vol. 12, 1856, p. 83, pl. 3, figs. 8–11.

*Nodosaria mucronata* Reuss, Sitz. Akad. Wiss. Wien, vol. 62, 1870, p. 475, No. 30.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 506, pl. 62, figs. 27–31.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 223, pl. 44, fig. 10.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 311, pl. 57, fig. 2.

*Description.*—Test elongate, tapering, broadest near the apertural end, composed of few chambers; wall smooth, sutures flush but distinct, oblique, apical end of test often with a spine; aperture with a short neck at the acute end of the chamber, radiate.

Length up to about 1.50 mm.

*Distribution.*—The only previous record for this species in the North Pacific is a *Challenger* station in 345 fathoms, *Hyalonema*-ground off Japan, given by Brady. I have material from off the Hawaiian Islands, *Nero* station 2071 in 271 fathoms; from off Japan, *Albatross* station D4954 in 957 fathoms; and at four *Nero* stations,

1145, 1293, 1299, and 1302, between Guam and Japan, with depths, respectively, 2,119, 2,141, 1,817 and 1,331 fathoms.

At *Nero* station 1145 a specimen was found, plate 35, figures 6*a*, *b*, which may be compared to some of the abnormal specimens, figured by Brady and others. Such forms seem to occur rather frequently in this species.

NODOSARIA JAPONICA, new species.

Plate 28, fig. 4.

*Description.*—Test much elongate, large, tapering, composed of numerous cylindrical chambers, sutures of clear material, walls of chambers whitish; apical end often slightly bulbous at the beginning then somewhat contracting before again enlarging as chambers are added; walls smooth, sutures indistinct in outline, but very distinct on account of the difference in texture of the material forming them; last formed chamber in adult specimens often more rounded and distinct, aperture with a tapering neck which is fluted about the opening.

Length up to 16 mm.

*Distribution.*—This species has occurred off Japan at *Albatross* station D4900 in 139 fathoms, bottom temperature 52.9° F. This seems to be a well-distinguished species.

*Type-specimen.*—Cat. No. 8544, U.S.N.M.

NODOSARIA CATENULATA H. B. Brady.

Plate 25, fig. 3.

*Nodosaria catenulata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 515, pl. 63, figs. 32–34.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 312, pl. 58, fig. 2.

*Description.*—Test elongate, slender, straight or more often slightly arcuate, tapering; apical end bearing a well-developed spine; chambers numerous, elliptical or ovate, distinctly separated by deep sutures; walls smooth, ornamented by four or six equidistant longitudinal costæ bridging the depressions between the chambers but usually not continuous over the chambers; costæ more or less rounded; aperture small at the end of a long tapering neck, the apertural end of which is costate giving a stellate appearance in end view.

Length up to 2 mm.

*Distribution.*—Brady described this species from off the Philippine Islands in 95 fathoms. The only other North Pacific record I have for this species is *Albatross* station H2922 in 268 fathoms off the Hawaiian Islands. Brady records it also from Torres Strait and it is apparently a warm-water species.

The figured specimen is a young one consisting of but three chambers. The view by transmitted light shows the relation of the chambers and the wall.

NODOSARIA LONGIROSTRATA, new species.

Plate 27, fig. 8.

*Description.*—Test elongate, composed of few very elongate chambers, sutures slightly depressed, wall smooth, aperture at the end of a long tubular neck, somewhat clavate at the tip with several flange-like extensions, bicarinate.

Length of broken specimen 2.50 mm.

*Distribution.*—Type-specimen, Cat. No. 8545, U.S.N.M., from *Albatross* station D4949 in 110 fathoms, off Japan, bottom temperature 57.8° F.

This is a very elongate species, the chambers being several times as long as wide and the peculiar form of the apertural end makes it especially distinctive.

NODOSARIA SCALARIS (Batsch).

Plate 24, fig. 7.

"Orthoceratia Flosculi" Soldani, Testaceographia, vol. 1, pt. 2, 1791, p. 91, pl. 95, figs. B–M.

*Nautilus (Orthoceras) scalaris* Batsch, Conch. des Seesandes, 1791, No. 4, pl. 2, figs. 4*a*, *b*.

*Nodosaria scalaris* Parker and Jones, Philos. Trans., vol. 155, 1865, p. 340, pl. 16, figs. 2*a*, *b*, *c*.—Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 4, vol. 8, 1871, p. 157, pl. 9, fig. 42.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 510, pl. 63, figs. 28–31.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 223, pl. 44, figs. 6, 19.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 73, pl. 13, figs. 716–718.

*Nodosaria longicauda* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 254, No. 28.

*Description.*—Test composed of few nearly spherical chambers, rapidly increasing in size as added, apical end often with a spine, surface ornamented with numerous longitudinal raised costæ, aperture at the end of a fairly long neck ornamented with transverse ring-like costæ.

Length 1.50–3.00 mm.

*Distribution.*—From the material I have examined this species seems to be the most common in the region. Brady records it from two *Challenger* stations, off the Philippines, 95 fathoms, and off the south coast of Japan on the *Hyalonema*-ground, 345 fathoms. Bagg records it from *Albatross* station H4566 in 572 fathoms off the Hawaiian Islands. I have had material from a large number of stations, off the Hawaiian Islands, off Guam, and especially between Guam and Japan. The depth varies from 84 to 1,503 fathoms.

There is a considerable variation in the number and prominence of the costæ in different specimens and also in the various chambers of the same specimen as in plate 24, figure 7. The aperture is interesting, often being surrounded by several tooth-like prominences.

### NODOSARIA RAPHANUS (Linnæus).

Plate 26, figs. 12, 13.

"Cornu Hammonis erectum striatum" PLANCUS, Conch. Min., 1739, p. 15, pl. 1, fig. 6.

"Orthoceras minimum" etc. GAULTIERI, Index Test., 1742, pl. 19, fig. L.

*Nautilus raphanus* LINNÆUS, Syst. Nat., ed. 12, 1767, p. 1164, (Gmelin's), ed. 13, 1788, p. 3372, No. 16.

*Orthocera raphanus* LAMARCK, Anim. sans. Vert., vol. 7, 1822, p. 593, No. 1; Tabl. Encycl. et Méth., pl. 465, fig. 2*a*, *b*, *c*.

*Nodosaria raphanus* PARKER and JONES, Ann. Mag. Nat. Hist., ser. 3, vol. 3, 1859, p. 477.—SILVESTRI, Atti Accad. Gioenia, Catania, ser. 3, vol. 7, 1872, p. 43, pl. 4, figs. 67–81.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 512, pl. 64, figs. 6–10.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 64.

Goës in the paper last quoted above records this species from *Albatross* station D3353 in 695 fathoms, one small specimen. I have been unable to find a specimen so labeled in the Goës collection, and as there are no other records for the species in this region the record must remain a doubtful one.

### NODOSARIA OBLIQUA (Linnæus).

Plate 25, fig. 5.

"Orthoceras minimum" etc. GAULTIERI, Index Test., 1742, pl. 19, fig. N.

*Nautilus obliquus* LINNÆUS, Syst. Nat., ed. 12, 1767, p. 1163 (Gmelin's), ed. 13, 1788, p. 3372, No. 14.

*Nodosaria (Dentalina) obliqua* PARKER and JONES, Ann. Mag. Hist., ser. 3, vol. 3, 1859, p. 482.

*Nodosaria obliqua* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 513, pl. 64, figs. 20–22.—H. B. BRADY, PARKER, and JONES, Trans. Zoöl. Soc. London, vol. 12, 1888, p. 223, pl. 44, fig. 7.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 63.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 311, pl. 57, fig. 4.

*Description.*—Test long and tapering, composed of numerous chambers, slightly inflated toward the apical end, more inflated and distinctly separated toward the apertural end, apical end usually with a single large spine, surface of the test with numerous distinct costæ running longitudinally the length of the test, aperture with an elongate neck smooth or nearly so.

Length up to 8–10 mm. or even more.

*Distribution.*—Brady speaks of this species as found in "every sea and at almost every depth from the laminarian zone to 1,500 to 2,000 fathoms." Goës found specimens from two stations off the west coast of North America, *Albatross* D3376 in 1,132 fathoms and D3407 in 885 fathoms. I have seen a few broken specimens only in the region.

NODOSARIA VERTEBRALIS (Batsch).

Plate 32, fig. 1.

*Nautilus* (*Orthoceras*) *vertebralis* BATSCH, Conch. des Seesandes, 1791, p. 3, No. 6, pl. 2, fig. 6*a*, *b*.

*Nodosaria vertebralis* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 514, pl. 63, fig. 35; pl. 64, figs. 11–14.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 312, pl. 57, fig. 5.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 312, pl. 57, fig. 5.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 144.

*Description.*—Elongate, slender, tapering, straight or very slightly arcuate, chambers comparatively short, numerous, little inflated, sutures of clear shell material, appearing darker than the opaque portions; surface ornamented with longitudinal costæ, apical end usually with a short spine.

Length up to 6 mm.

*Distribution.*—The only record from the North Pacific is that of Bagg, *Albatross* station D4000 in 104–213 fathoms off the Hawaiian Islands. From its distribution this seems to be a species of comparatively warm shallow water of tropical and subtropical seas.

NODOSARIA HIRSUTA d'Orbigny.

Plate 28, fig. 3.

"Orthoceratia quasi hispida" SOLDANI, Testaceographia, vol. 2, 1798, p. 15, pl. 2, fig. P.

"Orthoceratia hispida" SOLDANI, Testaceographia, vol. 2, 1798, p. 36, pl. 11, figs. *n–z*, A, B.

*Nodosaria hirsuta* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 252, No. 7.

*Nodosaria hispida* D'ORBIGNY, For. Foss. Bass. Tert. Vienne, 1846, p. 35, pl. 1, figs. 24, 25.—PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 4, vol. 8, p. 154, pl. 9, fig. 45.—SILVESTRI, Atti Accad. Gioenia, Catania, ser. 3, vol. 7, 1872, p. 80, pl. 9, figs. 207–228.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 507, pl. 63, figs. 12–16.—BALKWILL and WRIGHT, Trans. Roy. Irish Acad., vol. 28, 1885, p. 343, pl. 12, fig. 31.—SHERBORN and CHAPMAN, Journ. Roy. Micr. Soc., 1886, p. 748, pl. 14, fig. 32.—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc. London, vol. 12, 1888, p. 223, pl. 44, figs. 3, 5.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 343, pl. 11, fig. 16.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 311, pl. 57, fig. 1.—MILLETT, Journ. Roy. Micr. Soc., 1902, p. 515.

*Description.*—Test tapering, elongate, composed of few chambers, globular, surface covered with spines of varying coarseness, chambers close set or separated by stolonlike connections, aperture at the end of a tubular neck.

Length up to 2.5 mm.

*Distribution.*—Brady records this species from a *Challenger* station off the Philippines in 95 fathoms. The only specimen I have referable to this species is from D4900 off Japan in 139 fathoms, bottom temperature 52.9° F. This specimen which is figured here is somewhat broken and is not typical.

## Genus LINGULINA d'Orbigny, 1826.

*Lingulina* D'ORBIGNY (type *L. carinata* d'Orbigny), Ann. Sci. Nat., vol. 7, 1826, p. 256.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 517.

*Description.*—Test compressed, chambers arranged in a linear series, usually closely set; aperture usually elongate, corresponding to the form of the chamber.

This genus seems to be less clearly defined than many of the genera established by d'Orbigny. It is closely related to *Nodosaria*, differing from this genus only in the compressed character and the consequent changes in the aperture.

Species of this genus are few in number but have a wide range. It is most common as a fossil in the Miocene.

### LINGULINA CARINATA d'Orbigny.

Plate 29, fig. 3.

*Lingulina carinata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 257, No. 1; Modèles No. 26.—BARKER, WEBB, and BERTHELOT, Hist. Nat. Iles Canaries, vol. 2, pt. 2, Foraminifères, 1839, p. 124, pl. 1, figs. 5, 6.—WILLIAMSON, Rec. Foram. Great Britain, 1858, p. 14, pl. 2, figs. 33–35.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 517, pl. 65, figs. 16, 17.—BALKWILL and WRIGHT, Trans. Roy. Irish Acad., vol. 28, 1888, p. 343.—SHERBORN and BAILEY, Journ. Roy. Micr. Soc., 1890, p. 558, pl. 10, fig. 3.—WRIGHT, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 484.—EGGER, Abh. kön. bay. Acad. Wiss. München, Cl. II, vol. 18, 1893, p. 345, pl. 11, fig. 8, 20.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 312, pl. 58, fig. 3.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 144.

*Nodosaria carinata* GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 74, pl. 13, figs. 714–715 [?].

*Description.*—Test compressed, chambers in a linear series, early ones short and broad, later ones usually hyaline, edges nearly acute, surface smooth; aperture an elongated, simple ellipse without a definite neck or radiate openings.

Length up to 3 mm.

*Distribution.*—In the North Pacific, Brady records this species from the *Challenger* dredgings, off the Honolulu coral reefs, Hawaiian Islands, in 40 fathoms. Bagg records it as rare off the same islands, *Albatross* station 4508, in 495 fathoms. This is the specimen figured here.

Many forms have been figured as belonging to this species which it does not seem should be placed here, as their characters are so unlike the type of d'Orbigny's species.

## Genus TRIPLASIA Reuss, 1854.

*Vaginulina* d'Orbigny (part), Ann. Sci. Nat., vol. 7, 1826, p. 258.
*Orthocerina* d'Orbigny (part) in De la Sagra, Hist. Fis. Pol. Nat., Cuba, 1839, "Foraminifères," p. 18.
*Triplasia* Reuss, Denkschr. Akad. Wiss. Wien, vol. 7, abth. 1, 1854, p. 65.
*Rhabdogonium* Reuss, Sitz. Akad. Wiss. Wien, vol. 40, 1860, p. 198.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 524.

*Description.*—Test elongate, triangular or quadrangular in cross section, chambers numerous, uniserial or somewhat irregular; wall hyaline, surface smooth or roughened, aperture at the end of a short tubular neck.

There has been some dispute as to the names for this genus. D'Orbigny applied the name *Vaginulina* to a species of this genus, but as this name had been used previously in a different sense it is not available here. He also described *Orthocerina*, but the original species described under this genus is probably a *Clavulina* as nearly as can be determined. Therefore it can not be used here. The next name, *Triplasia*, was used by Reuss for three-angled species. *Rhabdogonium* was a later name which he used because four-angled species had been found and Reuss thought *Rhabdogonium* a more appropriate name. He put *Triplasia* as a synonym of *Rhabdogonium* and places there his type species of *Triplasia* (*Triplasia murchisonii*). As a result it seems that *Triplasia* must, by all laws of priority, be used instead of *Rhabdogonium*.

### TRIPLASIA TRICARINATA (d'Orbigny).

Plate 39, fig. 2.

*Vaginulina tricarinata* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 258 No. 4; Modèles, No. 4.
*Rhabdogonium tricarinatum* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 525, pl. 67, fig. 1–3.—Sherborn and Chapman, Journ. Roy. Micr. Soc., 1886, p. 752, pl. 15, fig. 16.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 223, pl. 45, fig. 3.—Schrodt, Zeitschr. deutsch. geol. Ges., vol. 42, 1890, p. 411, pl. 22, fig. 2.—Burrows, Sherborn, and Bailey, Journ. Roy. Micr. Soc., 1890, p. 558, pl. 10, fig. 7.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 484.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 355, pl. 11, figs. 49, 50; pl. 12, figs. 36–38.—Chapman, Proc. Zool. Soc., London, 1895, p. 33.—Silvestri, Mem. Pont. Accad. Nuovi Lincei, vol. 12, 1896, p. 194, pl. 1, fig. 8.—Millett, Journ. Micr. Soc., 1902, p. 525.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 145.

*Description.*—Test elongate, slightly tapering toward either end, often somewhat twisted, triangular in cross section, aperture in the center at the end of the chamber, usually with a short tubular neck and phialine lip; angles of the test carinate.

Length about 0.4 mm.

*Distribution.*—The *Challenger*, from Brady's records, did not obtain this species from the North Pacific. Goës records it at *Albatross* station 3395 in 730 fathoms. Bagg found it from about the Hawaiian Islands at 13 *Albatross* stations, very abundant, ranging in depth from 104 to 1,544 fathoms. I have obtained it from a number of stations about the Hawaiian Islands, off the west coast of America, and Guam, and off Japan, depths ranging from 181 to 1,355 fathoms.

TRIPLASIA REUSSII, new name.

Plate 39, fig. 3.

*Rhabdogonium minutum* H. B. Brady (not *R. minutum* Reuss), Rep. Voy. *Challenger*, Zoology, vol 9, 1884, p. 526, pl. 67, figs. 4–6.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 145.—Chapman, Journ. Linn. Soc. London, Zool., vol. 30, 1910, p. 412 [?].

*Description.*—Test thick and short, triangular in cross section, chambers few, somewhat elongate, somewhat carinate, walls roughish, thick; aperture with a short neck, fairly large, often with a fringe-like cutting about the opening.

Length, about 0.8 mm.

*Distribution.*—Brady found this species off the Ki Islands, southwest of New Guinea, 129 fathoms. Bagg records it from several stations about the Hawaiian Islands in 104 to 1,544 fathoms.

This species is rare in the North Pacific. It can easily be distinguished from *T. tricarinatum* by its more irregular form, short, thick chambers, roughened surface, and different apertural characters.

To unite this recent tropical species with *Rhabdogonium minutum* Reuss is rather a difficult problem, as Reuss's figure shows a compressed form entirely different in all its general characters. As the recent species seems to be entirely distinct from the fossil species described by Reuss from Galicia, a new name is here given to the recent species.

## Genus CRISTELLARIA Lamarck, 1812.

*Nautilus* (part) Linnæus, Syst. Nat., ed. 12, 1767, p. 1162.
*Lenticulites* (part) Lamarck, Annales du Muséum, vol. 5, 1804, p. 188.
*Cristellaria* Lamarck, (Type, *Cristellaria calcar* (Linnæus)) Extract Cours Zool., 1812, p. 122.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 534.

*Description.*—Test planospiral, typically close coiled, but becoming much uncoiled in some species; chambers numerous; wall hyaline, perforate; variously ornamented; aperture usually distinctly radiate.

This genus is one of the most interesting of the various genera of the Lagenidæ. It shows a great range of characters along several lines. The test may be close coiled typically, but in some species becomes uncoiled early, and the resulting development is often almost

Nodosarian, but the chambers usually keep an oblique tendency and the sutures usually oblique, at least in side view. Some species are very much compressed, while others are tumid or strongly umbonate. The surface of the test may be smooth or it may be variously ornamented with costæ, limbate sutures, knobs and bosses, spines or combinations of them and often the peripheral border is broadly keeled. Altogether except for *Lagena* it presents a greater range of ornamentation than any genus of the Lagenidæ. The aperture is usually very characteristic, being distinctly radiate and in some species being visible in many of the earlier chambers even when adult size is reached.

The genus is widely distributed geographically and bathymetrically, although it undoubtedly reaches its greatest development in comparatively shallow water—less than 500 fathoms—in rather warm waters, as about tropical islands. It is, however, found in great numbers in colder waters, but the species are fewer in number and lack the extravagant ornamentation seen in the tropical species. Geologically the range of the genus is a long one, its earliest limits not being satisfactorily determined.

There are several names of Montfort which were used previously to the use of *Cristellaria* by Lamarck, but these are ill defined and the poorly executed figures makes it impossible without a study of the types to say just what species the author had in mind. With such an ill-defined condition it seems ill advised at the present time to replace *Cristellaria* with any of Montfort's names. With a study of the types it may be necessary to do this.

CRISTELLARIA CULTRATA (Montfort).

Plate 29, fig. 4.

"Cornu Hammonis" PLANCUS, Conch. Min., 1760, p. 120, pl. 1, fig. 12.

"Nautili (*Lenticulae marginatae*)" SOLDANI, Testaceographia, vol. 1, pt. 1, 1789, p. 54, pl. 33, fig. B.

*Robulus cultratus* MONTFORT, [?] Conch. Syst., vol. 1, 1808, p. 214, 54e genre.

*Robulina cultrata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 287, No. 1; Modèles, No. 82; Foram. Foss. Bass. Tert. Vienne, 1846, p. 96, pl. 4, figs. 14, 15.

*Cristellaria cultrata* PARKER and JONES, Philos. Trans., vol. 155, 1865, p. 344, pls. 13, 17, 18; pl. 16, fig. 5.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 550, pl. 70, figs. 4, 5, 6.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 352, pl. 12, figs. 8–10, 24, 25.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 318, pl. 65, fig. 2.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 147.

*Description.*—Test very similar to that of *C. rotulata*, but with the added character of a peripheral keel of greater or less extent.

Length up to 4 mm.

*Distribution.*—Brady records this species from a single North Pacific station, off the Philippines in 95 fathoms. Bagg records it

from three *Albatross* stations, off the Hawaiian Islands; D4000 in 104–213 fathoms; H4566 in 572 fathoms; and H4696 in 367 fathoms.

Fine large specimens occur off the Pacific coast of the United States and in Bering Sea in comparatively shallow cold water. Occasional specimens occur off Japan being common at one station, *Albatross* D5056 in 258 fathoms, bottom temperature 46° F. It also occurred off the Hawaiian Islands, *Albatross* H3007 in 323 fathoms.

The main distinguishing character between this species and *C. rotulata* is the presence of the broad keel in *C. cultrata*. The distribution, at least so far as is shown by the North Pacific material examined, is by no means coextensive in the two species.

#### CRISTELLARIA RENIFORMIS d'Orbigny.

Plate 30, fig. 4; plate 33, fig. 1.

*Cristellaria reniformis* d'Orbigny, Foram. Foss. Bass. Tert. Vienne, 1846, p. 88, pl. 3, figs. 39, 40.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 539, pl. 70, figs. 3*a*, *b*.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 315, pl. 62, fig. 2.—Bagg, Bull. 513, U. S. Geol. Survey, 1912, p. 66, pl. 19, figs. 2*a*, *b*.

*Description.*—Test compressed, somewhat elongated, early chambers forming a close coiled test, later chambers becoming longer and a tendency toward an elongate form is shown, with oblique sutures; wall smooth; peripheral border slightly to strongly keeled; aperture often slightly produced, radiate.

Length up to 5 mm.

*Distribution.*—Brady records this species from the North Pacific in 2,050 fathoms in the *Challenger* report, but in the volume on the Summary of Results it is also recorded from *Challenger* station 237 in 1,875 fathoms. I have had material which seems to belong to this species from three *Albatross* stations, D4310, D4972 in 440 fathoms, bottom temperature 39.8° F., and D5078 in 514 fathoms, bottom temperature 38.9° F., off Japan. It also occurred at *Nero* station 1302 in 1,331 fathoms, also off Japan.

#### CRISTELLARIA ARTICULATA Reuss.

Plate 31, fig. 1.

*Robulina articulata* Reuss, Sitz. Akad. Wiss. Wien, vol. 48, 1863, p. 53, pl. 5, fig. 62.

*Cristellaria articulata* Reuss, Sitz. Akad. Wiss. Wien, vol. 62, 1870, p. 483.—von Schlicht, Foram. Pietzpuhl, 1870, pl. 17, figs. 5–12.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 547, pl. 69, figs. 10–12.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 317, pl. 64, fig. 2.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 146.

*Description.*—Test close coiled, nearly circular in side view, thick, chambers tumid, sutures depressed; periphery obtusely angled; aper-

ture exserted, broad and rounded in side view, radiate; umbonal portion of test often of clear shell material.

Length up to 3 mm.

*Distribution.*—Bagg records this species from a single *Albatross* station H4696 in 376 fathoms off the Hawaiian Islands. I have had material from four stations, all off Japan; H4882 in 248 fathoms, bottom temperature 48.8° F.; D4893 in 106 fathoms, bottom temperature 55.9° F.; D4895 in 95 fathoms; and D4964 in 37 fathoms, bottom temperature 66.6° F.

### CRISTELLARIA ROTULATA (Lamarck).

Plate 35, fig. 3.

"Cornu Hammonis seu Nautili" Plancus, Conch. Min., 1739, p. 13, pl. 1, fig. III.

*Lenticulites rotulata* Lamarck, Ann. Mus., vol. 5, 1804, p. 188, No. 3; vol. 8, 1806, pl. 62, fig. 11.

*Cristellaria rotulata* d'Orbigny, Mém. Soc. Géol. France, ser. 1, vol. 4, 1840, p. 26, pl. 2, figs. 16–18.—Parker and Jones, Philos. Trans., vol. 155, 1865, p. 345, pl. 13, fig. 19.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 547, pl. 69, figs. 13*a*, *b*.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 224, pl. 64, fig. 15.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 351, pl. 12, figs. 1, 2, 32, 33.—Fornasini, Mem. Accad. Sci. Ist. Bologna, ser. 5, vol. 3, 1893, p. 435, pl. 2, fig. 11; vol. 4, 1894, p. 221, pl. 3, figs. 24, 25.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, 1894, p. 60, pl. 10, figs. 559–578; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 54.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 317, pl. 64, fig. 4.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 148; Bull. 513, U. S. Geol. Surv., 1912, p. 67, pl. 19, figs. 5*a*, *b*.

*Description.*—Test large, close coiled, chambers numerous, lenticular, biconvex; wall smooth, thick; peripheral margin rather acute, but not distinctly carinate; apertures of all chambers of visible test usually apparent.

Length 1.5 to 4 mm.

*Distribution.*—Brady records this species from a single North Pacific *Challenger* station 232 in 345 fathoms south of Japan. Goës records it from seven *Albatross* stations in the eastern Pacific at depths varying from 660 to 1,201 fathoms. Bagg records it from two stations near the Hawaiian Islands, *Albatross* D4000 in 104 to 213 fathoms and H4430 in 1,544 fathoms. I have had material from *Albatross* station D3346 in 19 fathoms off Alaska and from several stations near Japan, depths ranging from 437 to 712 fathoms and the bottom temperatures from 37.5° to 39.8° F.; also from several *Nero* stations in the same area.

This species seems to differ from *C. cultrata* (Montfort) in the lack of a definite keeled periphery, but many intermediate forms are found, and such specimens are with difficulty placed in either one of the two extreme forms.

### CRISTELLARIA NITIDA d'Orbigny.

Plate 32, fig. 2.

"Nautili Lituitati" Soldani, Testaceographia, vol. 1, pt. 1, 1789, p. 64, pl. 64, figs. O, P.

*Cristellaria nitida* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 291, No. 5.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 549, pl. 70, figs. 2*a*, *b*.

*Description.*—"A feeble modification belonging to the '*cassis*' and '*mamilligera*' group. The shell is compressed and carinate and the earlier sutures limbate. It is a doubtful and unsatisfactory species."

Length 1.4 mm.

*Distribution.*—The only record for this somewhat doubtful species in the North Pacific is that given by Brady in the *Challenger* Report, 95 fathoms off the Philippines.

The description and figure are taken from the *Challenger* Report.

### CRISTELLARIA ORBICULARIS (d'Orbigny).

Plate 36, figs. 4, 5.

"Nuclei conico rotundati" Soldani, Testaceographia, vol. 2, 1798, App., p. 138, pl. 1, fig. 12. *p*, P.

*Robulina orbicularis* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 288, pl. 15, figs. 8, 9.

*Cristellaria orbicularis* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 549, pl. 69, fig. 17.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 317, pl. 64, fig. 3.—[?] Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 148.

*Description.*—Test very similar to *C. vortex*, but the periphery extended into a distinct keel, varying in width.

Length 1 to 1.5 mm.

*Distribution.*—Bagg records this species from *Albatross* station H4508 in 495 fathoms near the Hawaiian Islands as rare. I have material from *Albatross* stations off Japan, D4807 in 44 fathoms; D4887 in 71 fathoms, bottom temperature 59.7° F.; D4891 in 181 fathoms, bottom temperature 50.2° F.; and D4900 in 139 fathoms, bottom temperature 52.9° F. It also occurred at *Nero* station 203 in 1,625 fathoms near the Midway Islands.

This species seems to be very slightly different from *C. vortex*, except in the character of the keel. The specimens figured by Flint seem to me to be rather different in most cases from the typical form figured by d'Orbigny. The sutures are much less oblique, the chambers much shorter, and the whole seems unlike the type.

CRISTELLARIA VORTEX (Fichtel and Moll).

Plate 32, fig. 3.

"Nautili globuli" SOLDANI, Testaceographia, vol. 1, pt. 1, 1879, p. 66, pl. 59, fig. *tt*.

*Nautilus vortex* FICHTEL and MOLL, Test. Micr., 1803, p. 33, pl. 2, figs. *d–i*.

*Polystomella vortex* BLAINVILLE, Man. de Malac., 1825, p. 389.

*Robulina vortex* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 288, No. 4.

*Cristellaria vortex* PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 4, vol. 8, 1871, p. 240, pl. 10, fig. 82.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 548, pl. 69, figs. 14–16.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 317, pl. 65, fig. 1.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 148.

*Description.*—Test close coiled, biconvex, umbonate; chambers elongate, curved, the sutures making a long curve from the periphery to the umbo; peripheral margin acute but not distinctly carinate; wall smooth.

Length 1 to 1.5 mm.

*Distribution.*—Bagg records this species from a single *Albatross* station H4508 in 495 fathoms off the Hawaiian Islands. I have had specimens from *Albatross* H3007 in 323 fathoms also off the Hawaiian Islands and *Nero* station 990 in 859 fathoms off Guam.

CRISTELLARIA CONVERGENS Bornemann.

Plate 34, fig. 3.

*Cristellaria convergens* BORNEMANN, Zeitschr. deutsch. Geol. Ges., vol. 7, 1855, p. 327, pl. 13, figs. 16, 17.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 546, pl. 69, figs. 6, 7.

*Description.*—Test oval, biconvex, close coiled; chambers triangular, the last formed one drawn out to a point at the apertural end; sutures hardly visible, the chambers embracing to the umbo; wall smooth and thick.

Length about 1 mm.

*Distribution.*—Brady records this species at a single *Challenger* station 224 in 1,850 fathoms in the North Pacific. I have had material referable to this species from numerous stations, most of them off Japan. It occurred at two *Nero* stations 1208 in 665 fathoms and 1213 in 808 fathoms off Yokohama and at numerous *Albatross* stations in the same region with a range of depth from 361 to 649 fathoms, the bottom temperatures ranging from 38.1° F. to 42.7° F. The species also occurred at one *Tuscarora* station No. 58 in 814 fathoms, lat. 26° 52′ N., and long. 142° 21′ E.

The most striking characters of this species are the extension of the alar projections laterally over the sides of the test with a consequent obscuring of the sutural lines.

CRISTELLARIA ACUTAURICULARIS (Fichtel and Moll).

Plate 35, fig. 2.

"Hammoniæ subrotundæ" Soldani, Testaceographia, vol. 1, pt. 1, 1789, p. 61, pl. 49, fig. X.

*Nautilus acutauricularis* Fichtel and Moll, Test. Micr., 1803, p. 102, pl. 18, figs. *g–i*.

*Cristellaria acutauricularis* Parker and Jones, Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 114.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 543, pl. 114, figs. 17*a*, *b*.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 353, pl. 12, figs. 19, 20.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 316, pl. 63, fig. 5.

*Description*.—Test thick, slightly elongate; early chambers close coiled, later ones elongate and oblique; sutures somewhat depressed; wall smooth, apertural end rather pointed.

Length less than 1 mm.

*Distribution*.—The only published record for this species in the North Pacific is that of Brady in the *Challenger* Report. It occurred off the Philippines in 95 fathoms. I have had material referable to this species only from *Nero* 2055 in 536 fathoms near the Hawaiian Islands.

This species is close to *C. crepidula*, from which it seems to differ only in the less compressed and less elongate form of the test.

CRISTELLARIA GIBBA d'Orbigny.

Plate 35, fig. 1.

*Cristellaria gibba* d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 63, pl. 7, figs. 20, 21.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 546, pl. 69, figs. 8, 9.—Burrows, Sherborn, and Bailey, Journ. Roy. Micr. Soc., 1890, p. 259, pl. 10, figs. 19, 21.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 352, pl. 12, figs. 21, 27.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, 1894, p. 61, pl. 10, figs. 287, 288.—Fornasini, Mem. Accad. Sci. Ist. Bologna, ser. 5, vol. 4, 1894, p. 221, pl. 3, fig. 20.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 55.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 317, pl. 64, fig. 1.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 147.

*Description*.—Somewhat oval; biconvex; inner face decidedly contracted; peripheral margin somewhat keeled; wall smooth; sutures not depressed; apertures of earlier chambers usually apparent, even in adult condition.

Length usually 1 to 1.5 mm.

*Distribution*.—Goës records this species from a single *Albatross* station in the eastern Pacific, D3376 in 1,132 fathoms. Bagg records it from two stations off the Hawaiian Islands, *Albatross* D4000 in 104 to 213 fathoms and H4694 in 865 fathoms. I have had material from one *Nero* station, 2055 off the Hawaiian Islands in 536 fathoms and from three *Albatross* stations off Japan, D4958 in 405 fathoms, bottom temperature 40.1° F.; D5055 in 124 fathoms, bottom temperature 56.6° F.; and H4882 in 248 fathoms, bottom temperature

48.8° F. It also occurred at *Tuscarora* station 1, lat. 27° 7′ N., and long. 142° 7′ E. in 73 fathoms.

### CRISTELLARIA VARIABILIS Reuss.

Plate 36, figs. 1–3.

*Cristellaria variabilis* Reuss, Denkschr. Akad. Wiss. Wien, vol. 1, 1849, p. 369, pl. 46, figs. 15, 16.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 541, pl. 68, figs. 11–16.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 224, pl. 44, fig. 12.—Burrows, Sherborn, and Bailey, Journ. Roy. Micr. Soc., 1890, p. 560, pl. 10, fig. 22.—Egger, Abh. kön. bay. Akad. Wiss., München, Cl. II, vol. 18, 1893, p. 353, pl. 12, figs. 16–18.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 1894, p. 62, pl. 10, figs. 593–595.—Flint, Rep. U. S. Nat. Mus., p. 316, pl. 63, fig. 1.—Millett, Journ. Roy. Micr. Soc., 1903, p. 256, pl. 5, fig. 1.

*Description.*—Test compressed, varying in form according to stage in development, early stages nearly circular, later becoming elliptical or oblong; chambers comparatively few, high and broad; surface smooth, sutures very slightly depressed, in adult specimens the periphery keeled; aperture in adults somewhat produced, the outer border irregularly dentate.

Length usually not much exceeding 1 mm.

*Distribution.*—Brady records this species from a single *Challenger* station, 232, on the *Hyalonema*-ground, south of Japan in 345 fathoms. I have had it from but four stations, *Albatross* stations off Japan, D4897, 207 fathoms, bottom temperature 49.7° F.; D4949, 110 fathoms, bottom temperature 57.8° F.; D4970 in 500 fathoms, bottom temperature 39.1° F.; and D5056 in Suruga Gulf, Japan, 258 fathoms, bottom temperature 46.0° F.

This species is distinct from most others of the genus in its few high, broad chambers, taking but a very few to make a complete convolution and in the peculiar form of the aperture with its almost ragged appearance at the periphery.

### CRISTELLARIA CREPIDULA (Fichtel and Moll).

Plate 29, figs. 5, 6; plate 31, figs. 2–5.

*Nautilus crepidula* Fichtel and Moll, Test. Micr., 1803, p. 107, pl. 19, figs. *g–i*.
*Cristellaria crepidula* d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 64, pl. 8, figs. 17, 18.—Parker and Jones, Philos. Trans., vol. 155, 1865, p. 344, pl. 13, figs. 15, 16; pl. 16, fig. 4.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 542, pl. 67, figs. 17, 19, 20; pl. 68, figs. 1, 2.—Fornasini, Mem. Accad. Sci. Ist. Bologna, ser. 4, vol. 10, 1890, p. 471, pl. 2, figs. 31–33, 56–60.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 350, pl. 11, figs. 51, 52; pl. 12, figs. 34, 35.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, 1894, p. 62, pl. 11, figs. 599, 600; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 57.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 316, pl. 63, fig. 2.—Millett, Journ. Roy. Micr. Soc., 1903, p. 254.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 51, No. 9, 1907, p. 7, pl. 2, fig. 1.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 146.

*Description.*—Test elongate, compressed, early chambers close coiled, later ones becoming uncoiled, elongate; sutures slightly depressed; wall smooth; periphery rounded, without a keel.

Length up to 3 mm.

*Distribution.*—Brady records this species from 40 fathoms off the coral reefs of Honolulu, Hawaiian Islands, and in the *Challenger* volume on "Summary of Results," it is also recorded from *Challenger* station 246 in 2,050 fathoms. Goës records it from two *Albatross* stations, D3375 and D3376, in 1,201 and 1,132 fathoms, respectively, in the eastern Pacific. Bagg records it at four *Albatross* stations in the vicinity of the Hawaiian Islands; D4000 in 104–213 fathoms; H4430 in 1,544 fathoms; H4508 in 495 fathoms; and H4694 in 865 fathoms.

I have had specimens from numerous *Nero* stations about the Hawaiian Islands, west of Midway Island, and between Guam and Japan, ranging in depth from 518 to 2,080 fathoms. Off the Galapagos I have had it from D2806 in 1,379 fathoms, and off Japan at the following stations: D4949 in 110 fathoms, bottom temperature 57.8° F.; D4966 in 290 fathoms, bottom temperature 44.1° F.; and D4967 in 244 fathoms, bottom temperature 45.9° F.

### CRISTELLARIA LATA (Cornuel).

Plate 35, fig. 4.

*Marginulina lata* Cornuel, Mém. Soc. géol. France, ser. 2, vol. 3, 1848, p. 252, pl. 1, figs. 34–37.

*Planularia pauperata* Jones and Parker, Quart. Journ. Geol. Soc., vol. 16, 1860, p. 454, pl. 20, fig. 39.—H. B. Brady, Proc. Somerset Arch. and Nat. Hist. Soc., vol. 13, 1867, p. 110, pl. 2, figs. 24, 25.

*Cristellaria lata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 539, pl. 67, fig. 18*a*, *b*.

*Description.*—Test broad, subtriangular in side view, much compressed, early chambers somewhat close coiled, later ones very elongate and uncoiling, sutures very slightly depressed, oblique, wall smooth, aperture somewhat produced, radiate.

Length up to 2 mm.

*Distribution.*—This species has been previously unrecorded from the North Pacific. I have had specimens from the three following stations, *Albatross* D4843, in 100 fathoms, bottom temperature 39.9° F., off Japan, and *Tuscarora* 11, in 437 fathoms, lat. 33° 46′ N.; long. 140° 21′ E. and *Tuscarora* 126, in 500 fathoms, lat. 54° 08′ N.; long. 161° 31′ W.

This species seems to be a broadened development of a form like *C. crepidula*, but seems to have characters which make it distinct from that species.

### CRISTELLARIA TRICARINELLA Reuss.

Plate 34, figs. 1, 2.

*Cristellaria tricarinella* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, 1862, p 68, pl. 7, fig. 9; pl. 12, figs. 2–4.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 540, pl. 68, figs. 3, 4.

*Description.*—Test elongate, greatly compressed; earliest chambers close coiled, following ones soon becoming elongate, but extending back to the previous coil, giving an elongate subtriangular form to the later developed portion, sutures limbate; periphery of the test with a flange-like keel at each side, the border between them concave or with a median raised keel in addition to the lateral ones, wall unornamented except for the limbate sutures and keeled periphery.

Length 1.5–2 mm.

*Distribution.*—Brady records this species in the North Pacific from one *Challenger* station off the Philippines in 95 fathoms. The only North Pacific stations from which I have had material are *Albatross* D4840 in 154 fathoms, bottom temperature 39.9° F., and D4900 in 139 fathoms, bottom temperature 52.9° F., off Japan. This is the same region from which so many southern species seem to reach their northern limits, that it is not surprising to find this species there, which is really from its distribution a species of tropical waters.

### CRISTELLARIA TRICARINELLA Reuss, var. SPINIPES, new variety.

Plate 33, fig. 2.

*Description.*—Like the typical but the early chambers of the close coiled portion showing limbate sutures and the apical end of the test bearing a large stout spine.

*Type-specimen.*—Cat. No. 8546, U.S.N.M., from *Albatross* station D4900 in 139 fathoms, bottom temperature 52.9° F., off Japan.

### CRISTELLARIA CALCAR (Linnæus).

Plate 32, fig. 4.

"Nautilus minimus non umbilicatus" Gaultieri, Index Test., 1742, pl. 19, fig. C.

"Nautili (Lenticulæ radiatæ)" Soldani, Testaceographia, vol. 1, pt. 1, 1789, p. 54, pl. 33, figs. *aa*, *bb*.

*Nautilus calcar* Linnæus, Syst. Nat., ed. 12, 1767, p. 1162, No. 272; (Gmelin's) ed. 13, 1788, p. 3370, No. 2.

*Robulina calcar* d'Orbigny, Foram. Foss. Bass. Tert. Vienne, 1846, p. 99, pl. 4, figs. 18–20.

*Cristellaria calcar* Parker and Jones, Ann. Mag. Nat. Hist., ser. 2, vol. 19, 1857, p. 289, pl. 10, figs. 10–12.—Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 4, vol. 8, 1871, p. 242, pl. 10, fig. 91.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 551, pl. 70, figs. 9–15.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 224, pl. 44, fig. 14.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 318, pl. 66, fig. 1.—Fornasini, Mem. Accad. Sci. Ist. Bologna, ser. 5, vol. 10, 1902, p. 46, fig. 45.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 146.

*Robulina aculeata* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 289, No. 14.

*Description.*—Test close coiled, biconvex, umbonate; wall smooth, sutures distinct but hardly, if at all, depressed; periphery of test acute, with a distinct carina of greater or less width, with a long acicular spine opposite each chamber.

Length without spines about 1 mm.

*Distribution.*—Brady records this species from a single *Challenger* station in the North Pacific, 95 fathoms off the Philippines. Bagg records it from an *Albatross* station D4000 in 104 to 213 fathoms off the Hawaiian Islands. I have had specimens from one *Albatross* station H2922 in 268 fathoms and *Nero* station 2071 in 271 fathoms off the Hawaiian Islands and from several stations off Japan, depths ranging from 37 to 139 fathoms and bottom temperatures from 52.9° to 66.6° F. It is interesting to note that one of these stations, D4900, is one from which so many species recorded by Brady from the Philippines have been obtained.

From the above data the distribution of this species in the North Pacific at least seems to be largely in comparatively shallow, warm waters.

There seem to be two distinct forms at least which are included under this specific name. One of these is small in size, of comparatively few chambers in each whorl and with a few long acicular spines radially placed, the peripheral carina being narrow. The other is of much larger size, with many more chambers in each whorl and with many short broad flattened spinose projections extending somewhat backward from the wide peripheral carina and appearing as projections of the carina rather than as distinct spines.

The small form with the long acicular spines is the only one which I have seen in the North Pacific material. The synonymy is not clear on these two forms and it will be interesting to see if these are not really distinct from one another. The figures given by Flint show well the contrast in size and other characters between these two forms.

### CRISTELLARIA ECHINATA (d'Orbigny).

Plate 34, fig. 5.

"Nautili Echinati" etc. Soldani, Testaceographia, vol. 1, pt. 1, 1789, p. 65, pl. 59, figs. *qq*, *rr*.

*Nautilus calcar*, var. e, Fichtel and Moll, Test. Micr., 1803, p. 74, pl. 12, figs. *a*, *b*, *c*.

*Robulina echinata* d'Orbigny, Foram. Foss. Bass. Tert. Vienne, 1846, p. 100, pl. 4, figs. 21, 22.

*Cristellaria* (*Robulina*) *echinata* Carpenter, Parker, and Jones, Intr. Foram., 1862, pl. 12, fig. 3.

*Cristellaria echinata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 554, pl. 71, figs. 1–3.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 318, pl. 66, fig. 2.

*Description.*—Test close coiled, composed of comparatively few chambers, biconvex, umbonate; sutures limbate, in the earlier

development tending to break up into a series of raised rounded bosses, the largest near the umbo and thence diminishing in size toward the periphery, in the last-formed chambers the whole becoming a single raised ridge; wall between the sutures in the earlier development closely set with small raised papillæ becoming less numerous or wanting on the later-formed chambers; periphery with a slight keel and each chamber with a long acicular spine.

Length without spines about 2 mm.

*Distribution.*—The only North Pacific record for this beautiful species is that given by Brady, a single *Challenger* station off the Philippines in 95 fathoms.

This species combines many of the characters of *C. calcar* and *C. papillosa.*

CRISTELLARIA PAPILLOSA (Fichtel and Moll).

Plate 37, fig. 2.

*Nautilus papillosus* Fichtel and Moll, Test. Micr., 1803, p. 82, pl. 14, figs. *a-c.*
*Cristellaria papillosa* Parker and Jones, Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 113, No. 17.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 553, pl. 70, fig. 16.

*Description.*—Test close coiled, composed of numerous chambers, peripheral margin acute but not distinctly carinate; biconvex, sutures limbate, the thickenings developing into a series of rounded knobs, largest near the umbo and gradually decreasing in size toward the periphery; the wall in the earlier development between the sutures is more or less covered with fine raised papillæ, but these are not developed in the last-formed chambers.

Length about 2 mm.

*Distribution.*—This species has not previously been recorded from the North Pacific. The only material I have had is from the Inland Sea of Japan, depth not recorded. It is typical.

CRISTELLARIA MAMILLIGERA Karrer.

Plate 34, fig. 6.

*Cristellaria mamilligera* Karrer, *Novara* Exped., Geol. Theil., vol. 1, pt. 2, 1864, p. 76, pl. 16, fig. 5.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, p. 553, pl. 70, figs. 17, 18.

*Description.*—Test close coiled, composed of numerous, comparatively long-tapering chambers, sutures limbate, occasionally enlarging into rounded bosses at the inner end; test biconvex, somewhat umbonate; peripheral margin extended into a well-developed carina.

Length up to 2 mm.

*Distribution.*—Brady records this species in the North Pacific from a single *Challenger* station, 95 fathoms, off the Philippines. I have had material only from *Albatross* station D4900, off Japan, in 139

fathoms, bottom temperature 52.9° F. This is another example of the extension of the species recorded by Brady from the Philippines to southern Japan at this particular station.

CRISTELLARIA DENTICULIFERA, new species.

Plate 37, fig. 1.

*Cristellaria cultrata* H. B. Brady (part) (not *C. cultrata* Montfort), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 550, pl. 70, figs. 7, 8.

*Description.*—Test close coiled, biconvex, sutures somewhat limbate; wall of earlier chambers ornamented with longitudinal curved costæ often broken up into irregular tubercles; later chambers smooth and unornamented; peripheral border keeled, but the outer edge broken up into a series of tooth-like projections.

Length up to 2.5 mm.

*Type-specimen.*—Cat. No. 8547, U.S.N.M., from *Albatross* station D4900 in 139 fathoms, bottom temperature 52.9° F. off Japan.

This certainly seems to be a different species from typical *C. cultrata*. It differs in the limbate sutures, the smaller number of chambers in the coil, the surface ornamentation, and the denticulate character of the peripheral keel.

CRISTELLARIA GEMMATA H. B. Brady.

Plate 34, fig. 7.

*Cristellaria gemmata* H. B. Brady, Quart. Journ. Micr. Soc., vol. 21, 1881, p. 64, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 554, pl. 71, figs. 6, 7.

*Description.*—"Test planospiral, broad, oblong, compressed or complanate; lateral faces only slightly convex, dorsal edge acute or subcarinate; segments broad and arcuate, two or three of later ones free at both lateral margins; exterior ornamented with exogenous beads, arranged either upon the sutural lines, or, less frequently, in rows parallel to them."

"Length 1/20th inch (1.26 mm.)."

*Distribution.*—The only North Pacific record for this species is that given by Brady, a *Challenger* station off the Philippines in 95 fathoms.

CRISTELLARIA COSTATA (Fichtel and Moll).

Plate 34, fig. 4.

*Nautilus costatus* Fichtel and Moll, Test. Micr., 1803, p. 47, pl. 4, figs. *g–i*.
*Spincterules costatus* Montfort, Conch. Syst., 1808, p. 222, genre 56°.
*Lenticulina costata* De France, Dict. Sci. Nat., vol. 32, 1824, p. 182.
*Robulina costata* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 289, No. 13 [?].
*Cristellaria costata* Parker and Jones, Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 113, No. 19.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 555, pl. 71, figs. 8, 9.

*Description.*—Test close coiled, chambers comparatively few to each volution, sutures limbate; surface ornamented by numerous

stout costæ in general parallel with the periphery of the test; apertural angle decidedly acute.

Length about 1 mm.

*Distribution.*—This species has not previously been reported from the North Pacific. The only material I have seen is from *Nero* station 203 in 1,625 fathoms, bottom temperature 35° F., west of Midway Islands.

This is a remarkable occurrence for this species, which by its previous recorded distribution seems to have been taken in comparatively warm and shallow water.

CRISTELLARIA ELEGANTISSIMA (Costa).

Plate 36, fig. 7.

*Robulina elegantissima* COSTA, Atti Accad. Pont., vol. 7, pt. 2, 1856, p. 198, pl. 19, fig. 4.

*Cristellaria elegantissima* GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, 1894, p. 64, pl. 11, figs. 641, 642.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 147.

*Description.*—Test compressed with the earlier development close coiled, later chambers elongate, taking on a tendency toward uncoiling, early chambers ornamented with closely set, rather acute costæ, parallel to the periphery of the test, sutures indistinct, not limbate; later chambers smooth, ornamentation persisting longest on the periphery; peripheral border with a narrow but very distinct keel; apertural angle prominent.

Length about 1.25 mm.

*Distribution.*—Bagg records this species from a single *Albatross* station, H4508, in 495 fathoms off the Hawaiian Islands. This specimen I have examined and it is here figured.

This species differs from *C. costata* in the form of the test and in the ornamentation which here is close set and rather acute while in *C. costata* the costæ are coarser and rounded.

CRISTELLARIA WETHERELLII Jones, var. SUBLINEATA, new variety.

Plate 33, fig. 4.

*Description.*—Test at first close coiled, later becoming uncoiled and crozier-shaped; curved; compressed, sutures depressed, portion of chamber wall between the sutures ornamented with rows of tubercles in linear rows both transversely and longitudinally, in later growth tending to fuse into a raised ridge.

Length about 5 mm.

*Type-specimen.*—Cat. No. 8548, U.S.N.M., from *Albatross* station D4900 in 139 fathoms, bottom temperature 52.9° F., off Japan. This is the first occurrence of this species in the North Pacific, and the form is not the typical one.

### CRISTELLARIA SUBALATA H. B. Brady.

Plate 30, figs. 5–7.

*Cristellaria obtusata* Reuss, var. *subalata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 536, pl. 66, figs. 24, 25.
*Cristellaria subarcuatula* Goës (part, not *C. subarcuatula* Montagu), Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 57.

*Description.*—Test much elongated, earliest chambers close coiled, later ones very early becoming uncoiled and developing an elongate, compressed test, with oblique, slightly depressed sutures; wall smooth; initial end of the test, with a broad flaring plate-like keel, not extending up the peripheral margin, or at least only slightly, bearing numerous concentric lines of growth and usually with radial markings as well; aperture radiate, terminal.

Length up to 5 mm.

*Distribution.*—Under the name *C. subarcuatula* Goës has recorded this species from two stations in the eastern North Pacific, *Albatross* D3375, 1,201 fathoms, and D3407 in 885 fathoms.

An examination of Goës's specimens from these stations shows them to be of the form here figured rather than that shown[1] by Goës, who simply used as illustrations copies of his figures in the "Report upon the Arctic and Scandinavian Foraminifera" previously published.[2] In reality the specimens found by Goës at these North Pacific stations as is shown by Goës's own material are identical with the form figured by Brady in the *Challenger* Report as noted above. In many of its characters this form seems worthy of specific rank and its relation to *C. obtusata* Reuss is very doubtful. I have taken the liberty of raising it to specific rank.

### CRISTELLARIA SCHLOENBACHI Reuss.

Plate 36, fig. 6.

*Cristellaria schloenbachi* Reuss, Sitz. Akad. Wiss. Wien, vol. 46, 1862, p. 65, pl. 6, figs. 14, 15.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 539, pl. 67, fig. 7.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 315, pl. 63, fig. 4.—Millett, Journ. Roy. Micr. Soc., 1903, p. 253.

*Description.*—Test much elongate, compressed, early portion close coiled for a few chambers, then gradually assuming an uncoiled straight form, but with the sutures oblique, the chambers high; surface smooth, sutures slightly depressed, peripheral border rounded; aperture terminal, radiate.

Length about 2 to 2.5 mm.

*Distribution.*—Although not previously recorded from the North Pacific, the species occurred at *Albatross* station D4875 in 59 fathoms, eastern channel of Korea Strait.

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[1] Bull. Mus. Comp. Zoöl., vol. 29, 1896, pl. 5, figs. 19–24.
[2] Kongl. Svensk. Vet. Akad. Handl., vol. 25, 1894, p. 63, pl. 11, figs. 630–637.

### CRISTELLARIA LATIFRONS H. B. Brady.

Plate 38, fig. 2.

*Cristellaria latifrons* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 544, pl. 68, fig. 19; pl. 113, fig. 11*a*, *b*.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 316, pl. 63, fig. 3.

*Description.*—Test elongate, tapering toward either end, triangular in transverse section; early chambers close coiled, later ones uncoiling elongate, very broad on the inner face, each chamber extending well back toward the preceding coil, its marginal angles acute or obtusely rounded, peripheral margin of the test angular.

Length 0.6 to 1.5 mm.

*Distribution.*—This species has not previously been recorded from the North Pacific. The only station from which I have had material is *Albatross* D4966 in 290 fathoms, bottom temperature 44.1° F., off Japan. The material was very typical.

In the form of the chambers this is very different from *C. italica*, in which the chambers are shorter and do not extend back to the initial whorl.

### CRISTELLARIA ITALICA (De France).

Plate 33, fig. 3.

*Saracenaria italica* De France, Dict. Sci. Nat., vol. 32, 1824, p. 177; vol. 47, 1827, p. 344; Atlas Conch., pl. 13, fig. 6.—Blainville, Man. de Mal., 1825, p. 370, pl. 5, fig. 6.

*Cristellaria* (*Saracenaria*) *italica* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 293, No. 26; Modèles, Nos. 19 and 85.

*Cristellaria italica* Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, pp. 21, 32, pl. 1, figs. 41, 42.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 544, pl. 68, figs. 17, 18, 20–23.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 350, pl. 12, figs. 22, 23, 26, 40–42.—Fornasini, Mem. Accad. Sci. Ist. Bologna, ser. 5, vol. 4, 1894, p. 219, pl. 3, fig. 8; vol. 5, 1895, p. 12, pl. 4, fig. 28.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 316, pl. 63, fig. 6.

*Description.*—Test stout, trihedral, triangular in cross section, early chambers close coiled, later ones uncoiling but short, not extending back to the earlier volutions; sutures somewhat depressed; wall smooth; face of the last formed chamber nearly triangular.

Length of North Pacific specimens usually less than 2 mm.

*Distribution.*—Apparently this species has not been recorded from the North Pacific. I have had specimens from but two *Albatross* stations, D4874 in 66 fathoms and D4972 in 440 fathoms, bottom temperature 39.8° F., both off Japan. At both these stations the specimens were small.

## Genus MARGINULINA d'Orbigny, 1826.

*Marginulina* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 258 (type, *M. glabra* d'Orbigny).—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 526.

*Description.*—Test subcylindrical, early portion close coiled, later chambers uncoiled, rounded in transverse section, last formed chambers often inflated; aperture in early chambers marginal, later often becoming nearly median, usually radiate.

This genus is not well characterized, and the limits between it and the much uncoiled species of *Cristellaria* are not at all well defined.

### MARGINULINA GLABRA d'Orbigny.

Plate 23, fig. 3.

*Marginulina glabra* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 259, No. 6; Modèles, No. 55.—Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 27, pl. 1, fig. 36.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 527, pl. 65, figs. 5, 6.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28 (Sci.), 1885, p. 344, pl. 12, figs. 24, 25.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 346, pl. 11, figs. 28, 29.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 313, pl. 60, fig. 1.

*Vaginulina glabra* Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 59.

*Description.*—Test short, stout, early chambers close coiled, later ones uncoiled, subcylindrical, inflated, sutures depressed, surface smooth; aperture usually radiate.

Length up to 2.5 mm.

*Distribution.*—Brady records this species from two *Challenger* stations in the North Pacific off Japan in 345 and 2,150 fathoms. Goës records it from *Albatross* station D3376 in 1,132 fathoms off the west coast of America. I have found it but very rarely in the material I have examined.

### MARGINULINA STRIATULA, new species.

Plate 23, fig. 4.

*Description.*—Test elongate, early part forming a portion of a coil, later chambers moniliform, tumid, separated by deep constrictions; wall with numerous very fine longitudinal striæ; aperture at the end of a well developed neck, four-radiate.

Length nearly 2 mm.

*Type-specimen.*—Cat. No. 8549, U.S.N.M., from *Nero* station 2071 in 271 fathoms off the Hawaiian Islands.

The finely striate surface and the apertural characters will easily distinguish the species.

## Genus VAGINULINA d'Orbigny, 1826.

*Vaginulina* d'Orbigny (type *V. legumen* Linnæus), Ann. Sci. Nat., vol. 7, 1826, p. 257.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 529.

*Description.*—Test elongate, chambers in a linear series, placed so that the sutures are oblique, aperture marginal, chambers laterally compressed.

The genus *Vaginulina* is a more or less convenient one for certain compressed forms which have, in common, oblique sutures and a marginal aperture. Among the fossil forms this genus has no definite position, but its place as a genus, including recent species, is not a very stable one.

### VAGINULINA LEGUMEN (Linnæus)

Plate 39, fig. 4.

*Nautilus legumen* Linnæus, Syst. Nat., ed. 10, 1758, p. 711, No. 248; ed. 12, 1767, p. 1164, No. 288.

*Vaginulina legumen* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 257, No. 2.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 530, pl. 66, figs. 13–15.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 58.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 314, pl. 60, fig. 2.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 145.

*Description.*—Test compressed laterally, composed of several chambers, sutures distinct, often the wall below being translucent, earlier not distinguishable in contour, later ones often somewhat tumid and distinguishable, length of individual chamber variable; initial end with or without a spine; wall smooth and polished, aperture marginal on a somewhat extended neck, radiate.

Length 2 mm. or more.

*Distribution.*—This species is recorded by Bagg at *Albatross* station D4174 in 735 to 865 fathoms and H4567 in 1,307 fathoms off the Hawaiian Islands. I have had specimens from *Nero* station 1254 in 264 fathoms and station 1464 in 891 fathoms and from Guam and Japan.

This species is somewhat variable in length of chamber and in the presence or absence of the terminal spine.

### VAGINULINA PATENS H. B. Brady.

Plate 32, figs. 7, 8.

*Vaginulina patens* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 533, pl. 67, figs. 15, 16.—Egger, Abh. kön. bay. Acad. Wiss. München, Cl. II, vol. 18, 1893, p. 348, pl. 11, figs. 44–47 [?].

*Description.*—"Test elongate, complanate, broadest near the middle, tapering to a point at the apertural end; aboral end broad and rounded, but finishing in a short, stout spine. Dorsal edge thin, nearly straight, ventral margin thickest near the middle, square or somewhat bicarinate.

Segments about 12 in number; long, narrow, slightly bent; obliquely set or nearly erect."

"Length $\frac{1}{35}$ inch (0.74 mm.)."

*Distribution.*—Described and figured by Brady from specimens dredged by the *Challenger* in 95 fathoms off the Philippines. The specimens figured by Egger seem rather doubtfully the same as Brady's, but the figures lack detail.

VAGINULINA PROTUMIDA (Schwager).

Plate 30, fig. 1.

*Nodosaria protumida* Schwager, *Novara* Exped., Geol. Theil. vol. 2, 1866, p. 227, pl. 6, fig. 59.

*Description.*—Test elongate, tapering, arcuate, early chambers somewhat oblique, sutures indistinct, later chambers much inflated; wall ornamented with numerous longitudinal raised costæ, increasing in number as chambers are added; apical portion very tapering; aperture at the end of a long slender neck.

Length about 3 mm.

*Distribution.*—Schwager described this species from the Tertiary of Kar Nicobar. The figured specimen is from *Albatross* station D4966, off Japan in 290 fathoms, bottom temperature 44.1° F.

Evidently this belongs to *Vaginulina* rather than *Nodosaria*. The apertural neck in the figured specimen is broken, but otherwise it agrees very well with Schwager's figure.

## Genus FRONDICULARIA De France, 1824.

*Frondicularia* De France (type, *F. complanata* De France), Dict. Sci. Nat., vol. 32, 1824, p. 178.

*Description.*—Test compressed, in the adult consisting of chambers, elongate and narrow, running back on either side of the test; wall vitreous, finely perforate; aperture single, either radiate or surrounded with a lip which is usually cut in a radial manner; surface smooth or ornamented with costæ; microspheric specimens with a coiled development in the earlier chambers; megalospheric specimens without the coiled chambers as a rule.

The genus *Frondicularia* is interesting in showing very clearly the differences between the microspheric and megalospheric forms in the same species. Formerly the coiled microspheric forms were called *Flabellina*, but it has been shown that instead of generic differences these early stages represent the complete phylogenetic development seen in so many species only in the microspheric form. In the megalospheric form with its much larger proloculum the coiled chambers are few or are not developed at all. This difference in the development is shown in the accompanying outline figures.

As a fossil genus *Frondicularia* is very well represented from the Triassic onward, being very abundant, both in number of species and individuals in some horizons. In the present ocean, except in certain restricted regions, it is almost unknown. There are but few living species

FRONDICULARIA BRADYI, new name.

Plate 23, fig. 5; plate 39, fig. 5.

*Frondicularia spathulata* H. B. Brady (not *F. spathulata* Williamson) Quart. Journ. Micr. Sci., vol. 19, 1879, p. 56, pl. 8, figs. 5*a*, *b*; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 519, pl. 65, fig. 18.—Sidebottom, Mem. Proc. Manchester Lit. and Philos. Soc., vol. 51, No. 9, 1907, p. 5, pl. 1, fig. 26.

*Description.*—Test elongate, compressed, narrow; chambers comparatively few in number, proloculum largest, elliptical, more rotund than the later chambers; chambers following the proloculum reflexed; those of the later development often less so; aperture terminal, elliptical; sutures slightly depressed; surface smooth.

Length about 0.5 mm.

*Distribution.*—Brady obtained material of this species from off the Ki Islands, 129 fathoms, and off Raine Island, 155 fathoms. In the *Challenger* Report, page 520, he also mentions the only North Pacific record, as follows: "Mr. F. W. Millett has the same from the coast of Korea, 40 fathoms." Sidebottom records the species from the coast of the island of Delos (Grecian Archipelago) as very rare. His specimen from the Bay of Palermo and Egger's single specimen from the Gazelle expedition, both of which are referred to this species, would seem best referred to *F. nitida* Terquem, as Millett has already suggested in regard to Egger's specimen. The single specimen I have had from the North Pacific and which is here figured is from *Nero* station 990 in 859 fathoms, off Guam.

The proloculum of this species is very interesting, with its very thick wall and distinct canals. The following chambers are comparatively thin walled and lack the large canals of the proloculum.

FRONDICULARIA ROBUSTA H. B. Brady.

Plate 32, figs. 5, 6.

*Frondicularia robusta* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 523, pl. 66, figs. 1, 2.

*Description.*—"Test elongate, compressed, stoutly built; lateral margins nearly parallel, ends obtusely angular or rounded, peripheral edges thick, rounded, slightly lobulated. Segments numerous; nearly uniform in size after the initial stage, somewhat irregular in contour, comparatively little bent. Surface furnished with closely set, irregular or interrupted, longitudinal costæ."

"Length $\frac{1}{7}$ inch (3.6 mm.)."

*Distribution.*—Brady described this species from specimens from two localities: Off the Ki Islands, southwest of New Guinea, 129 fathoms, and on the coral reefs of Honolulu, Hawaiian Islands, 40 fathoms.

The species is a peculiar one in many respects, the ornamentation suggesting many of the Tertiary species, but the thickened form and broad rounded edges being distinct.

The figures and description are from Brady.

FRONDICULARIA ROBUSTA H. B. Brady, var. REPANDA, new variety.

Plate 29, figs. 1, 2.

*Frondicularia robusta* Bagg (not *F. robusta* H. B. Brady), Proc. U. S. Nat. Mus., vol. 34, 1908, p. 145.

*Description.*—Test compressed, broad, later chambers extending backward, giving the test a broadly fan-shaped form; otherwise like *F. robusta* H. B. Brady.

Length up to 2.5 mm.

*Distribution.*—Bagg's specimen is of this broad flaring form, found at *Albatross* station D4508 in 495 fathoms off the Hawaiian Islands. I have seen specimens which are here figured from *Albatross* stations H4881 (type-locality) in 316 fathoms and D4922 in 60 fathoms, off the southern part of Japan.

*Type-specimen.*—Cat. No. 8550, U.S.N.M.

This variety lacks the form of the typical, but has the same general character of ornamentation and rounded borders.

## Subfamily 3. POLYMORPHININÆ.

Test polythalamous; chambers arranged either biserially or in an irregular spiral; surface smooth or variously ornamented; aperture usually radiate.

This subfamily includes the genus *Polymorphina* and its closely allied form *Dimorphina*.

### Genus POLYMORPHINA d'Orbigny, 1826.

*Polymorphina* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 265.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 557.

*Description.*—Test more or less rounded, usually not equilateral, chambers few, obliquely placed in a more or less spiral arrangement; aperture terminal, usually radiate; wall calcareous, perforate, either smooth or variously ornamented with spines, costæ, or tubercles.

Although there are various modifications of *Polymorphina*, the unity of the whole is very well defined, the aperture is usually radiate and the modifications are largely along the lines of ornamentation and the arrangement, number, and form of the chambers.

**POLYMORPHINA LACTEA (Walker and Jacob).**

Plate 34, fig. 8.

"Serpula tenuis ovalis laevis" WALKER and BOYS, Test. Min., 1784, p. 2, pl. 1, fig. 5.

"Polymorpha Subcordiformia vel Oviformia" SOLDANI, Testaceographia, vol. 1, pt. 2, 1791, p. 114, pl. 112, figs. 11, *nn*, etc.

*Serpula lactea* WALKER and JACOB, Adams' Essays, ed. 2, 1798, p. 634, pl. 24, fig. 4.

*Vermiculum lacteum* MONTAGU, Test. Brit., 1803, p. 522.

*Polymorphina lactea* MAGILLIVRAY, Moll. Aberd., 1843, p. 320.—WILLIAMSON (part) Rec. For. Great Britain, 1858, p. 71, pl. 6, fig. 147.—H. B. BRADY, PARKER, and JONES, Trans. Linn. Soc. London, vol. 27, 1870, p. 213, pl. 39, fig. 1 *a–c*.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 559, pl. 71, fig. 11.—BURROWS, SHERBORN, and BAILEY, Journ. Roy. Micr. Soc., 1890, p. 561, pl. 11, fig. 9.—WRIGHT, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 486.—CRICK and SHERBORN, Journ. Northampton Nat. Hist. Soc., vol. 7, 1892, p. 71, fig. 25.—EGGER, Abh. kön. bay. Acad. Wiss. München, vol. 18, 1893, p. 308, pl. 9, figs. 8, 14, 15.—CHAPMAN, Journ. Roy. Micr. Soc., 1896, p. 9, pl. 2, fig. 3.—MORTON, Proc. Portland Soc. Nat. Hist., vol. 2, 1897, p. 119, pl. 1, fig. 7.—MILLETT, Journ. Roy. Micr. Soc., 1903, p. 261.—SIDEBOTTOM, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 51, No. 9, 1907, p. 9, pl. 2, fig. 11 [?].—CHAPMAN, Journ. Quekett Micr. Club, 1907, p. 131.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 149.

*Description.*—Test ovate, nearly symmetrical in transverse section, chambers few, elongate, separated by slightly depressed sutures; wall smooth.

Length about 0.5 mm.

*Distribution.*—This species was recorded by Brady from one *Challenger* station in the North Pacific, depth 2,300 fathoms, and by Bagg from *Albatross* station H4579 in 387 fathoms, off the Hawaiian Islands.

I have not found material which could be referred here. Bagg's specimens which I have examined are too poor for figuring. The figure given here is from Brady.

**POLYMORPHINA LACTEA (Walker and Jacob), var. DIFFUSA Jones and Chapman.**

Plate 41, fig. 8.

*Polymorphina lactea*, fistulose form, H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 560, pl. 73, fig. 14.

*Polymorphina* spp., var. *diffusa* JONES and CHAPMAN, Journ. Linn. Soc. London, vol. 25, 1896, p. 505, figs. 26–29.

*Polymorphina lactea* (WALKER and JACOB), var. *diffusa* CHAPMAN, Journ. Quekett Micr. Club, 1907, p. 131, pl. 10, fig. 1.

*Description.*—Early chambers similar to the typical *Polymorphina lactea*, but finally developing a "wild growth" of a fistulose form, usually spinose and irregular.

*Distribution.*—The specimen figured is from *Albatross* station D4900, Eastern Sea of Japan, 139 fathoms, bottom temperature 52.9° F. It has a much greater development of the fistulose chamber

than either of the other two specimens to which reference is given above. The earlier portion, however, is similar to *Polymorphina lactea.*

POLYMORPHINA AMYGDALOIDES Reuss.

Plate 41, fig. 5.

*Globulina amygdaloides* Reuss, Zeitschr. d. deutsch. geol. Ges., vol. 3, 1851, p. 82, pl. 6, fig. 47.

*Polymorphina amygdaloides* Reuss, Sitz. Kais. Akad. Wiss. Wien, vol. 18, 1855, p. 250, pl. 8, fig. 84.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 561, pl. 71, fig. 13.—Burrows and Holland, Proc. Geol. Assoc., vol. 15, 1897, p. 46, pl. 2, fig. 18.—Millett, Journ. Roy. Micr. Soc., 1903, p. 261.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 51, No. 9, 1907, p. 9, pl. 2, figs. 12–14.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 148.

*Polymorphina lactea* Walker and Jacob, var. *amygdaloides* H. B. Brady, Parker, and Jones, Trans. Linn Soc. London, vol. 27, 1870, p. 214, wood cuts.

*Description.*—Test oval, somewhat compressed, cross-section elliptical, chambers few, elongate, sutures only very slightly depressed; wall smooth.

Length 0.6 to 1 mm.

*Distribution.*—Bagg records the species from three *Albatross* stations in the vicinity of the Hawaiian Islands, D4017, 305 fathoms; D4174, 735–865 fathoms; and H4567, in 1,307 fathoms.

I have found no material to place in this species. The figures are drawn from the specimens recorded by Bagg.

POLYMORPHINA GIBBA d'Orbigny.

Plate 41, fig. 4.

"Polymorphina Subcordiformia vel Oviformia" Soldani, Testaceographia, vol. 1 to 2, 1791, p. 114, vol. 113, figs. *zz, C*, etc.

*Polymorphia* (*Globulina*) *gibba* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 226, No. 20; Modèles, No. 63.—Egger, Neues Jahrb. für Min., 1857, p. 288, pl. 13, figs. 1–4.

*Polymorphina gibba* H. B. Brady, Parker, and Jones (part), Trans. Linn. Soc. London, vol. 27, 1870, p. 216, pl. 39, figs. 2*a–d*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 561, pl. 71, figs. 12*a*, *b*.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 486.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 51, No. 9, 1907, p. 10, pl. 2, figs. 15–17.—Chapman, Journ. Quekett Micr. Club, 1907, p. 131.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 149.—Chapman, Proc. Roy. Soc. Victoria, vol. 22, 1910, p. 279.

*Globulina gibba* d'Orbigny, For. Foss. Vienne, 1846, p. 227, pl. 13, figs. 13, 14.

*Description.*—Test rotund, front view nearly circular, end view broadly oval; visible chambers few; broad sutures slightly excavated; wall smooth, aperture somewhat produced.

Length 0.75 to 1 mm.

*Distribution.*—Bagg records this species from one station only, *Albatross* H4430, rarely, in 1,544 fathoms, off the Hawaiian Islands. The specimen I have examined, and it is typical. I have a single specimen from *Albatross* D4807, in 44 fathoms, off Japan.

### POLYMORPHINA ANGUSTA Egger.

Plate 39, fig. 6.

*Polymorphina* (*Globulina*) *angusta* Egger, Neues Jahrb. für Min., 1857, p. 290, pl. 13, figs. 13–15.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 563, pl. 72, figs. 1–3.

*Description.*—Test elongate, compressed, cylindrical, apical end acute and subacute, apertural end obtuse, chambers comparatively few, elongate, sutures but very slightly depressed; wall smooth, aperture finely radiate.

Length 0.6 to 0.8 mm.

*Distribution.*—Brady records this species from one *Challenger* station in the North Pacific, station 241, in 2,300 fathoms. Bagg also records it in another, Hawaiian Islands, *Albatross* D4017, in 305 fathoms. Bagg's specimen which I have examined seems more like a *Quinqueloculina* than a *Polymorphina*, but it is too poor to make out surely. I have had specimens from three *Nero* stations, 170, northwest of the Hawaiian Islands toward Midway Island, 1,990 fathoms; station 1300 in 1,088 fathoms, and 1301 in 1,529 fathoms, both south of Japan.

### POLYMORPHINA LANCEOLATA Reuss.

Plate 40, fig. 2.

*Polymorphina lanceolata* Reuss, Zeitschr. d. deutsch. geol. Ges., vol. 3, 1851, p. 83, pl. 6, fig. 50; Sitz. kais. Akad. Wiss. Wien, vol. 62, 1870, p. 487, No. 12.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 564, pl. 72, figs. 5–6.

*Polymorphina fusiformis* H. B. Brady, Parker, and Jones (part), Trans. Linn. Soc. London, vol. 27, 1870, p. 219, pl. 39, figs. 5*b*, *c*.

*Description.*—Test elongate, compressed, cylindrical, fusiform, initial end rather acute, apertural end obtusely pointed; chambers several, smooth, elongate, tumid, sutures somewhat depressed, last formed chamber rather more inflated; wall smooth.

Length 1 to 1.25 mm.

*Distribution.*—This species has not previously been recorded for the North Pacific. Material referable here has been obtained at several *Nero* stations between Guam and Japan, depths between 1,529 and 2,119 fathoms. The species is not well distinguished from *Polymorphina rotundata*, differing especially in the more elongate form and less tapering outline.

POLYMORPHINA COMMUNIS d'Orbigny.

Plate 37, fig. 7.

*Polymorphina* (*Guttulina*) *communis* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 266, pl. 12, figs. 1–4; Modèles, No. 62.—Egger, Neues Jahrb., 1857, p. 288, pl. 13, figs. 16–18.

*Polymorphina communis* H. B. Brady, Parker, and Jones, Trans. Linn. Soc. London, vol. 27, 1870, pl. 39, p. 224, figs. 10*a*, *b*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 568, pl. 72, fig. 19.—Burrows and Holland, Proc. Geol. Ass., vol. 15, 1897, p. 46, pl. 2, fig. 14.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 319, pl. 67, fig. 2.—Millett, Journ. Roy. Micr. Soc., 1903, p. 263.—Chapman, Journ. Quekett Micr. Club, 1907, p. 131.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 51, No. 9, 1907, p. 11.

*Description.*—Test ovate, somewhat elongate, initial end broadly rounded, apertural end somewhat obliquely pointed; chambers few, inflated, sutures excavated; wall smooth.

Length 0.75 to 1 mm.

*Distribution.*—This species is recorded by Flint from *Albatross* station 2842 in 72 fathoms off Unalaska. Bagg records it from the Hawaiian Islands, but I am inclined, after examination, to place his specimens under *Polymorphina sororia*. I have seen specimens from *Tuscarora* station 11, in 437 fathoms in the eastern Pacific, and *Albatross* H4856 in 898 fathoms in Bering Sea. This species has more or less tumid chambers and a rounded initial end but is variable.

POLYMORPHINA OVATA d'Orbigny.

Plate 30, fig. 2.

*Polymorphina ovata* d'Orbigny, For. Foss. Vienne, 1846, p. 233, pl. 13, figs. 1–3.—Reuss, Sitz. kön. Akad. Wien, vol. 55, 1867, p. 91.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 564, pl. 72, figs. 7, 8.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 54.

*Description.*—"The test of this species has an oval but somewhat inequilateral outline and the two faces are almost equally convex; the oral end is obtuse, the aboral acuminate. The segments are arranged with regularity in two alternating series, the last pair occupying two-thirds of the visible shell. The sutures are complinate and are marked by fine lines without external depressions." Description copied from Brady.

*Distribution.*—Goës records this species as rare from *Albatross* station 3407 in 885 fathoms. This specimen is here figured.

POLYMORPHINA OVATA d'Orbigny, fistulose form.

Plate 40, fig. 4.

A specimen with long branching last-formed chambers was found in material from the Gulf of Sidra. The early chambers seem to be allied to *Polymorphina ovata*. It is an exceptionally branching and extended form.

### POLYMORPHINA OBLONGA d'Orbigny.

Plate 37, fig. 6.

*Polymorphina oblonga* D'ORBIGNY, For. Foss. Vienne, 1846, p. 232, pl. 12, figs. 29–31.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 569, pl. 73, figs. 2–4.—CHASTER, First Rep. Southport, Soc. Nat. Sci., 1890–91 (1892), p. 64, pl. 1, fig. 13.—EGGER, Abh. kön. bay. Acad. Wiss. München, Cl. II, vol. 18, 1893, p. 309, pl. 11, figs. 9, 10, 24.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 319, pl. 67, fig. 5.—MILLETT, Journ. Roy. Micr. Soc., 1903, p. 164.—SIDEBOTTOM, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 51, No. 9, 1907, p. 12, pl. 2, fig. 20.—CHAPMAN, Journ. Quekett Micr. Club, 1907, p. 132; Proc. Roy. Soc. Victoria, vol. 22, 1910, p. 280.

*Description.*—"The test is more or less compressed, and has six to eight visible segments which are somewhat oblong and inflated in contour and separated by excavated sutures."

Brady records this species from the North Pacific down to 2,050 fathoms. The species is recorded by Bagg, but an examination of his specimens show it to be an *Uvigerina* with a phialine lip on the opposite end from which the aperture would be if the specimen were a *Polymorphina* of this species. The description and figure are from Brady.

### POLYMORPHINA ROTUNDATA (Bornemann).

Plate 40, fig. 1.

*Guttulina rotundata* BORNEMANN, Zeitschr. d. deutsch. geol. Ges., vol. 7, 1855, p. 346, pl. 18, fig. 3.

*Polymorphina rotundata* REUSS, Sitz. Akad. Wiss. Wien, vol. 62, 1870, p. 487, No. 14.—VON SCHLICHT, Foram. Pietzpuhl, 1870, pl. 26, figs. 13–15; pl. 28, figs. 1–5; pl. 30, figs. 33–40.—H. B. BRADY, PARKER, and JONES, Trans. Linn. Soc. London, vol. 27, 1870, p. 234, p. 40, fig. 19*a–e* and wood cuts.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 570, pl. 73, figs. 5–8.

*Description.*—Test broadest at the apertural end, tapering rapidly toward the initial end; chambers several, earlier ones with slightly depressed sutures, later ones inflated, sutures deeper; aperture produced, radiate; wall smooth or with a slight indication of striæ.

Length 1.50 to 2 mm.

*Distribution.*—Brady records this species from *Challenger* station 224 in 1,850 fathoms. I have had material from *Nero* station 1287 in 1,606 fathoms between Guam and Japan.

### POLYMORPHINA SORORIA Reuss.

Plate 30, fig. 3.

*Polymorphina* (*Guttulina*) *sororia* REUSS, Bull. Acad. Roy. Belg., ser. 3, vol. 15, 1863, p. 151, pl. 2, figs. 25–29.

*Polymorphina sororia* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 562, pl. 71, figs. 15, 16.—CHAPMAN, Journ. Roy. Micr. Soc., 1896, p. 12, pl. 2, figs. 11, 12.—MILLETT, Journ. Roy. Micr. Soc., 1903, p. 265.

*Description.*—Test similar to *Polymorphina communis*, but the sutures less defined; chambers less inflated, apical end less rounded, whole test more fusiform.

Length 0.6 to 0.8 mm.

*Distribution.*—This species is recorded by Picaglia from long. 109° 58′ W.; lat. 0° 47′ N. in 4,670 meters.

Bagg's specimens referred by him to *Polymorphina communis* seem more properly to be placed here. His specimens are figured. They are from *Albatross* station H4585 in 689 fathoms near the Hawaiian Islands.

POLYMORPHINA COMPRESSA d'Orbigny.

Plate 40, fig. 3.

Polymorpha "Subovalia" Soldani, Testaceographia, vol. 1, pt. 2, 1791, p. 114, pl. 114, fig. F, I; pl. 115, fig. N; pl. 116, figs. V, X, etc.

*Polymorphina compressa* d'Orbigny, For. Foss. Vienne, 1846, p. 233, pl. 12, figs. 32–34.—H. B. Brady, Parker, and Jones, Trans. Linn. Soc. London, p. 227, pl. 40, figs. 12*a–f*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 565, pl. 72, figs. 9–11.—Mariani, Boll. Soc. Geol. Italia, vol. 7, 1888, p. 288, pl. 10, fig. 13.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 487.—Egger, Abh. kön. bay. Acad. Wiss. München, Cl. II, vol. 18, 1893, p. 309, pl. 9, figs. 11–13.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 58, pl. 10, figs. 539–553.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 319, pl. 67, fig. 3.—Millett, Journ. Roy. Micr. Soc., 1903, p. 262.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 51, No. 9, 1907, p. 13, pl. 3, figs. 1–6, 12, 13 [?].—Bagg, U. S. Nat. Mus., vol. 34, 1908, p. 149.—Chapman, Proc. Roy. Soc. Victoria, vol. 22, 1910, p. 280.

*Description.*—Test usually oblong, strongly compressed, chambers numerous, elongate, but often as broad as long in surface view except the last, in an alternating biserial arrangement, sutures somewhat excavated, surface somewhat smooth, but occasionally with traces of striæ near the initial end; aperture strongly radiate, often on a protuberant portion of chamber.

Length up to 3.15 mm.

*Distribution.*—Brady records this species from the North Pacific without station. Bagg records it from three stations off the Hawaiian Islands, D4017, 305 fathoms, H4430 in 1,544 fathoms, and H4694 in 865 fathoms. Of the two specimens of the Bagg material in Washington which I have examined, the specimen from D4017 is definitely a *Quinqueloculina* and that from H4694 too broken to determine.

Excellent specimens of this species were obtained from material dredged at *Albatross* station H4878 in 84 fathoms and D4825 in 120 fathoms, adjacent stations off the coast of Japan.

This seems to be a more clearly defined species than most of the others of the genus.

POLYMORPHINA ELEGANTISSIMA Parker and Jones.

Plate 38, fig. 1.

*Polymorphina elegantissima* PARKER and JONES, Philos. Trans. Roy. Soc., vol. 155, 1865, p. 438.—H. B. BRADY, PARKER, and JONES, Trans. Linn. Soc., vol. 27, 1870, p. 231, pl. 40, fig. 15*a–c*.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 566, pl. 72, figs. 12–15.—FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 319, pl. 67, fig. 4.—MILLETT, Journ. Roy. Micr. Soc., 1893, p. 263.—CHAPMAN, Journ. Quekett Micr. Club, 1907, p. 132, pl. 10, fig. 3; Proc. Roy. Soc. Victoria, vol. 22, 1910, p. 280.

*Description.*—Test ovate, initial end broad and rounded, apical end tapering, bluntly pointed, end view often subtriangular; chambers few but unequally biserial; wall smooth, sutures not depressed but of a darker color; aperture radiate, prolonged.

Length up to 1 mm.

*Distribution.*—This is evidently a tropical or subtropical species of comparatively shallow waters. It has been obtained in the Australian and the East Indian region. In the North Pacific Brady records it from Hongkong Harbor, 7 fathoms. I have had specimens collected from the Inland Sea of Japan, depth not given.

The arrangement of chambers in this species is peculiar for the genus, the biserial arrangement being oblique, so that the last-formed chamber on one side of the test covers all previously added chambers of that side and on the other side leaves the other set exposed. In this way there are a number of chambers visible from either side of the test.

POLYMORPHINA LONGICOLLIS H. B. Brady.

Plate 41, figs. 1–3.

*Polymorphina lanceolata* REUSS (part), Sitz. kön. Akad. Wiss. Wien, vol. 62, 1870, p. 487, No. 12.—VON SCHLICHT, Foram. Pietzpuhl, 1870, pl. 31, figs. 25–28, etc.
*Polymorphina longicollis* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 64; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 572, pl. 73, figs. 18, 19.

*Description.*—Test fusiform; chambers few, smooth inflated, especially the last-formed one, sutures but slightly excavated; surface more or less hispid, the last-formed chamber spinose; aperture with an elongate neck, often irregular, sometimes with a radiate lip.

Length about 0.75 mm.

*Distribution.*—This species has not previously been recorded for the North Pacific. I have had material from *Nero* station 2061 in 1,670 fathoms off the Hawaiian Islands and *Nero* station 1319 in 2,167 fathoms between Guam and Japan.

This seems to be essentially a deep-water species, the stations given by Brady averaging about this same depth.

A fistulose form which is hispid throughout and evidently belongs to this species was found at *Nero* station 1063, in 1,884 fathoms, in the line of soundings between Guam and Japan. It is here figured.

POLYMORPHINA REGINA H. B. Brady, Parker, and Jones.

Plate 41, figs. 6, 7.

*Polymorphina regina* H. B. Brady, Parker, and Jones, Trans. Linn. Soc. London, vol. 27, 1870, p. 241, pl. 41, figs. 32*a*, *b*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 571, pl. 73, figs. 11–13.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 310, pl. 9, figs. 45, 50, 51.—Millett, Journ. Roy. Micr. Soc., 1903, p. 265.—Chapman, Journ. Quekett Micr. Club, 1907, p. 132, pl. 10, fig. 4.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 149.—Chapman, Proc. Roy. Soc. Victoria, vol. 22, 1910, p. 281.

*Description.*—Test fusiform; chambers several, inflated, with deep sutures; wall ornamented with elongate, coarse costæ, usually not broken on the individual chambers; aperture radiate, produced.

Length 0.60 to 1 mm.

*Distribution.*—The only records for this species in the North Pacific are from the region of the Hawaiian Islands. Brady found it in the *Challenger* material from off Honolula in 40 fathoms. Bagg records it from *Albatross* station H4694 in 865 fathoms as rare, and I have found it in material from *Albatross* station H2922 in 268 fathoms. It seems to be a tropical species of comparatively shallow water.

### Subfamily 4. UVIGERININÆ.

Test composed of several chambers, typically spirally arranged, especially in the earlier portion, later chambers often becoming loosely arranged, or even uniserial; wall smooth or variously ornamented; aperture typically consisting of a neck with a definite phialine lip.

In *Uvigerina* the spirally arranged chambers are typical, old age characters appearing in the loss of ornamentation or in the tendency to become loosely spiral as in *U. interrupta*. In *Siphogenerina* the early chambers are spiral or biserial, especially well developed in the microspheric forms, and the later development is uniserial.

### Genus UVIGERINA d'Orbigny, 1826.

*Uvigerina* d'Orbigny (type, *U. pygmæa* d'Orbigny), Ann. Sci. Nat., vol. 7, 1826, p. 268.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 573.

*Description.*—Test elongate, spiral, consisting of numerous chambers, usually arranged triserially, occasionally in later growth with fewer than three chambers in each volution; wall calcareous, perforate, hyaline, smooth or ornamented with spines or costæ or modifications of them; aperture with usually a tubular neck at the end of which is a phialine lip.

The genus *Uvigerina* is one of the most clearly distinguished of any of the genera of the Foraminifera. Its triserial arrangement of chambers with a tubular aperture and phialine lip will at once serve

to distinguish it. In some of the species in the last-formed chambers there is a tendency to reduce the number of chambers in a volution to two, or even to become almost uniserial as in *Uvigerina interrupta* H. B. Brady. The surface ornamentation presents a considerable range from smooth and unornamented as in *U. canariensis* d'Orbigny, through the finely striate forms to ones with heavy costæ, and these may be broken into spines or the whole test may be spinose, as in *U. asperula* Czjzek and *U. interrupta* H. B. Brady. One of the most interesting forms of ornamentation in the genus is the secondary development of spines in *U. aculeata* d'Orbigny, developed in the later chambers first, but progressively extending backward and finally in some cases covering the entire test.

The genus *Uvigerina* is known from the Eocene through the later formations of the Tertiary to the present. Some of the species seem to have a limited distribution, both geographically and bathymetrically, but others, as *U. pygmæa* d'Orbigny, have a much wider range geographically and are found to considerable depths.

UVIGERINA CANARIENSIS d'Orbigny.

Plate 42, fig. 6.

"Testæ pineiforme sminusculæ" Soldani, Testaceographia, vol. 2, 1798, p. 18, pl. 4, figs. E, F, G, H.

*Uvigerina nodosa*, var. B d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 269, No. 3.

*Uvigerina canariensis* d'Orbigny, Foram. Canaries, 1839, p. 138, pl. 1, figs. 25–27.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 573, pl. 74, figs. 1–3.—Woodward and Thomas, 13th Ann. Rep. Geol. Nat. Hist. Survey Minnesota for 1884 (1885), p. 171, pl. 4, fig. 37; Geol. Nat. Hist. Survey Minnesota, vol. 3, 1893, p. 39, pl. D, fig. 9.—Egger, Abh. kön. bay. Akad. Wiss. München, cl. II, vol. 18, 1893, p. 311, pl. 9, fig. 43.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 52, pl. 9, figs. 489–492.—Millett, Journ. Roy. Micr. Soc., 1903, p. 266, pl. 5, fig. 7.—Sidebottom, Mem. Manchester Lit. and Philos. Soc., vol. 52, 1908, No. 13, p. 1, pl. 1, figs. 1, 2.—Chapman, Journ. Linn. Soc. Zool., vol. 30, 1910, p. 414.

*Uvigerina urnula* d'Orbigny, Foram. Foss. Bass. Test. Vienne, 1846, p. 189, pl. 11, figs. 21, 22.

*Uvigerina irregularis* H. B. Brady, Nat. Hist. Trans. Northumberland and Durham, vol. 1, 1865, p. 100, pl. 12, fig. 5.

*Description.*—Test elongate, made up of numerous chambers, spirally arranged, three chambers making up each whorl, chambers inflated, rotund, distinctly separated externally by rather deep sutures; wall smooth, occasionally the early chambers showing traces of costæ or spines; aperture usually with a tubular neck and broad phialine lip; color grayish-white.

Length 1 mm. or somewhat more.

*Distribution.*—From the material examined the species seems to be generally distributed in the North Pacific, for the most part in comparatively deep water. It has occurred in Bering Sea, in mate-

rial from the stomachs of holothurians dredged at *Albatross* station D3603 at 1,771 fathoms and from both the eastern and western sides of the North Pacific in depths from 1,597 to 2,112 fathoms. From the region of the Hawaiian Islands Bagg records it from three *Albatross* stations, D4000, D4025, and H4571 in from 104 to 384 fathoms. The least depth at which any of the material of this species which I have examined was dredged was at *Tuscarora* station 11 in 437 fathoms, about midway between the Hawaiian Islands and the California coast. Brady did not record the species from the North Pacific.

From the material at hand and a study of the published figures referred to this species it is evident that there is a considerable difference in the material referred here. Some of the figured specimens are fusiform, decidedly tapering at either end and with a long, drawn out tubular neck, others as in the figured specimen are much the largest near the apertural end. All are uniform in having the surface of the adult chambers smooth, but the early chambers are either smooth as in the type figure, or slightly costate (*U. urnula* d'Orbigny) or slightly spinose as in the figured specimen. A larger series should throw some light on the actual distribution of the various forms now included under this specific name.

#### UVIGERINA CANARIENSIS d'Orbigny, subspecies STRIATA Bagg.

*Uvigerina canariensis* d'Orbigny, subspecies *striata* Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 151, pl. 5, fig. 2.

*Description.*—"* * * A form which has definite striations extending in groups clear and well defined, though not closely set down, and over the last chamber as well as over the earlier segments as in *Uvigerina pygmæa*. The inflation of the segments is marked and the septa are depressed."

*Distribution.*—Bagg described this subspecies from material dredged off the Hawaiian Islands at *Albatross* station H4566 in 572 fathoms.

I have examined the type-specimen, but in the absence of sufficient material am inclined to leave it here until more may be available. The description is copied from the original. A single specimen very similar to that figured by Bagg was found in globigerina ooze at *Nero* station 172 in 2,086 fathoms near the Midway Islands.

#### UVIGERINA SELSEYENSIS Heron-Allen and Earland.

Plate 42, fig. 5.

*Uvigerina selseyensis* Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1909, p. 437, pl. 18, figs. 1–3.

*Description.*—Test subovate, broadest toward the apertural end, chambers numerous, early ones rotund, triserially arranged, later ones more or less trihedral, more loosely arranged; the outer lower mar-

gins somewhat angular and projecting, wall smooth, aperture with a very short broad neck with a narrow phialine lip.

Length about 0.35 mm.

*Distribution.*—This species, described as a European fossil, seems to occur in the North Pacific, specimens from *Albatross* station H2923 in 392 fathoms being very similar to *U. selseyensis*. The figure does not show the angular character of the periphery of the chambers, but this occurs and makes the resemblance much more striking, and the comparison made by the authors that the species resembles both *U. angulosa* and *U. porrecta* is well sustained.

UVIGERINA PROBOSCIDEA Schwager.

Plate 42, fig. 2.

*Uvigerina proboscidea* SCHWAGER, *Novara* Exped., Geol. Theil, 2, 1866, p. 250, pl. 7, fig. 96.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 312, pl. 9, fig. 53.

*Description.*—Test ovate, tapering somewhat at either end, chambers inflated, but closely set with sutures nearly flush, surface slightly hispid with very fine aculei, aperture with a tapering tubular neck with the greatest diameter near the base and a slightly phialine lip.

Length about 0.5 mm.

*Distribution.*—Not previously recorded from the North Pacific. Described from the Pliocene of Kar Nicobar and recorded by Egger from *Gazelle* station 90 off Western Australia. Specimens which seem to be this species were found at *Nero* station 1464 in 891 fathoms off Guam.

Although Brady places this species as a synonym of *U. canariensis*, it seems that it belongs rather with the hirsute group of the genus. Our specimens are very similar to the drawing of the type.

UVIGERINA STRIATA d'Orbigny.

Plate 43, fig. 5.

*Uvigerina striata* D'ORBIGNY, Voyage Amér. Mérid., 1839, vol. 5, pt. 5, "Foraminifères," p. 53, pl. 7, fig. 16.

*Uvigerina tenuistriata* BAGG (part) (not *U. tenuistriata* Reuss), Proc. U. S. Nat. Mus., vol. 34, 1908, p. 151.

*Description.*—Test elongate, fusiform, tapering rather abruptly toward either end, chambers numerous, three in each whorl, somewhat inflated and separated by fairly deep sutures, wall with fine longitudinal costæ somewhat interrupted; somewhat angul in end view; aperture with a short tapering tubular neck without a definite phialine lip.

Length 0.3 to 0.6 mm.

*Distribution.*—Specimens referred to *U. tenuistriata* Reuss by Bagg from *Albatross* station H4696 in 367 fathoms off the Hawaiian Islands

seem to fit excellently the figure and description of *U. striata* given by d'Orbigny. The finely costate tapering test and the characters of the apertural portion are very different from the more common material usually referred by authors to *U. pygmæa*.

UVIGERINA TENUISTRIATA Reuss.

Plate 42, fig. 4.

*Uvigerina tenuistriata* Reuss, Sitz. kais. Akad. Wiss. Wien, vol. 52, 1870, p. 485.—von Schlicht, Foram. Pietzpuhl, 1870, pl. 22, figs. 34–36.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 574, pl. 74, figs. 4–7.—Egger, Abh. kön. bay. Akad. Wiss., München, Cl. II, vol. 18, 1893, p. 315, pl. 9, figs. 44, 52.

*Description.*—Test elongate, subcylindrical, tapering at the apical end, composed of numerous rounded chambers with distinct sutures; wall with numerous fine raised longitudinal costæ, except the distal portion of the last-formed chamber, or in full-grown specimens more than the last chamber, with roughened or even nearly smooth walls; aperture with a short comparatively thick tubular neck with usually a distinct phialine lip.

Length about 1 mm.

*Distribution.*—Recorded by Brady in the North Pacific in 95 fathoms off the Philippines. I have not seen material definitely referable to this species from the North Pacific. Bagg's material which I have examined seems to belong to *U. striata*, although recorded by him under the name *tenuistriata*.

UVIGERINA STRIATULA, new species.

Plate 44, fig. 3.

*Description.*—Test elongate, fusiform, tapering gradually from the middle toward either end; composed of numerous inflated chambers, those last formed considerably drawn out, wall usually thin and translucent, finely and distinctly striated; aperture with a tubular neck and phialine lip.

Length about 0.5 to 0.7 mm.

*Distribution.*—Type-specimen, Cat. No. 8551, U.S.N.M., from *Nero* Station 1310 in 518 fathoms, globigerina ooze, near the Bonin Islands. It also occurred from the same region at *Nero* Station 1306 in 1,208 fathoms, also in globigerina ooze.

In its extreme modification this species has a general resemblance to *U. interrupta* H. B. Brady, but most of the specimens examined were less drawn out than is usual in that species.

### UVIGERINA PYGMÆA d'Orbigny.

Plate 42, fig. 1; plate 44, fig. 5.

"Polymorpha Pineiformia" Soldani, Testaceographia, vol. 1, pt. 2, 1791, pl. 130, figs. *ss*, *tt*.

*Uvigerina pigmea* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 269, pl. 12, figs. 8, 9; Modelès, 1826, No. 67.

*Uvigerina pygmæa* d'Orbigny, For. Foss. Bass. Test. Vienne, 1846, p. 190, pl. 11, figs. 25, 26.—Parker and Jones, Ann. Mag. Nat. Hist., ser. 2, vol. 19, 1857, p. 297, pl. 11, figs. 41–43.—Williamson, Rec. Brit. Foram., 1858, p. 66, pl. 5, figs. 138, 139.—Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 29, pl. 2, fig. 54.—Parker and Jones, Philos. Trans., vol. 155, 1865, p. 363, pl. 17, figs. 65*a*, *b*; pl. 13, fig. 54.—Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 4, vol. 8, 1871, p. 171, pl. 11, fig. 109.—Schwager, Boll. R. Com. Geol. Ital., vol. 8, 1877, p. 25, pl., fig. 34.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 19, No. 4, 1882, p. 59, pl. 4, figs. 68–70.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 575, pl. 74, figs. 11–14.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 224, pl. 45, figs. 1, 2.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 487.—Egger, Abh. kön. bay. Akad. Wiss., München, Cl. II, vol. 18, 1893, p. 314, pl. 9, fig. 42.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 51, pl. 9, figs. 496–501.—Chapman, Proc. Zool. Soc. London, 1895, p. 35.—Goës, Bull. Mus. Comp. Zoöl., vol. 26, 1896, p. 50.—Flint, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 320, pl. 68, fig. 2.—Millett, Journ. Roy. Micr. Soc., 1903, p. 269.—Chapman, Trans. New Zealand Inst., vol. 38, 1905 (1906), p. 99.—Sidebottom, Mem. Manchester Lit. and Philos. Soc., vol. 54, 1910, No. 16, p. 23.—Chapman, Journ. Linn. Soc. Zool., vol. 30, 1910, p. 414.

*Uvigerina bifurcata* d'Orbigny, Foram. Voyage Amér. Mérid., 1839, p. 53, pl. 7, fig. 17.

*Uvigerina semiornata* d'Orbigny, For. Foss. Bass. Tert. Vienne, 1846, p. 189, pl. 11, figs. 23, 24.

*Description.*—Test broadly ovate to subcylindrical, chambers numerous, inflated, with distinct sutures; wall with large, well-developed costæ, placed longitudinally, apical end rather bluntly rounded, the earliest chambers visible with costæ plainly developed; aperture with a short, stout tubular neck and a distinct phialine lip; color of the test white to a light brown.

Length 0.5 to 1 mm.

*Distribution.*—This species is one of the most widely distributed of the family, being found in all the ocean basins. In the North Pacific, Brady speaks of it as rare, but this was due to simple lack of material, for I found it widely distributed in all parts running northward into Bering Sea, where it is very common at several stations. As a rule it seems to be most abundant in cold waters and at the north in shallow water, while southward toward the Equator it seems to occur most frequently at a considerable depth where the water is again cold. Brady recorded the species from the Hawaiian Islands and Bagg records it from the same region at five *Albatross* stations. Goës records it from two stations off the west coast of America, one at

the entrance of the Gulf of California, the other southwest of Panama. In the material I have examined it has occurred frequently in the *Albatross*, *Nero*, and *Tuscarora* dredgings.

D'Orbigny's original figures of this species show a fusiform tapering test, in which the last-formed chambers lack the characteristic costæ and in which the tubular neck is long. Later in his Vienna Basin monograph he uses the same name for a test of different form, still fusiform but with a much shorter and stouter neck. In recent material, however, in almost all cases the later-formed chambers are broad and the test is much broader toward the apical end. The figures given by Brady, Parker, and Jones [1] of specimens from the Abrolhos Bank and by Flint [2] show the typical form so abundant in the cooler waters of recent seas.

### UVIGERINA SCHWAGERI H. B. Brady.

Plate 37, figs. 3, 4.

*Uvigerina schwageri* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 575, pl. 74, figs. 8–10.—Chapman, Proc. Zool. Soc. London, 1895, p. 35.

*Description.*—Test elongate, subovate, tapering to a blunt point at the aboral end; segments numerous, only slightly inflated externally; surface ornamented by a few ill-defined, partial costæ; color pure white.

Length 1.6 mm.

*Distribution.*—Brady records this species from 95 fathoms off the Philippines in the North Pacific as well as from off the Fiji Islands and Torres Strait. Chapman records it from the Arabian Sea. Outside of the Philippine region I have failed to find this species in the North Pacific.

The figures and description are from Brady.

### UVIGERINA BRUNNENSIS Karrer.

Plate 43, fig. 2.

*Uvigerina brunnensis* Karrer, Abh. k. geol. Reichs., vol. 9, 1877, p. 385, pl. 16*b*, fig. 49.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 577, pl. 75, figs. 4, 5.—Egger, Abh. kön. bay. Akad. Wiss. München, 1893, p. 312, pl. 9, figs. 60, 61.—Chapman, Proc. Zool. Soc. London, 1895, p. 36.

*Description.*—Test elongate, composed of numerous inflated chambers, wall with longitudinal costæ for the most part breaking up into rows of spinose projections longitudinally placed; aperture with a short stout neck with a broad phialine lip.

Length about 0.75 mm.

*Distribution.*—This species has not hitherto been recorded from the North Pacific. Brady's stations were off Christmas Harbor, Kerguelen Island, 120 fathoms, and off the western shore of Patagonia, 245

[1] Trans. Zool. Soc. London, vol. 12, 1888, pl. 45, figs. 1, 2.
[2] Ann. Rep. U. S. Nat. Mus., 1897 (1899), pl. 68, fig. 2.

fathoms. Egger also recorded it at two stations off Kerguelen at similar depths. Chapman records it from the Arabian Sea. I have had the species from numerous stations, only one, *Albatross* station H2764, 122 fathoms near the Hawaiian Islands, being less than a thousand fathoms. It has occurred at numerous *Nero* stations mostly between Guam and Yokohama in 1,415 to 2,135 fathoms.

Although the recent material does not agree very closely with Karrer's original description it may be left under that name.

### UVIGERINA ANGULOSA Williamson.

Plate 44, fig. 4.

*Uvigerina angulosa* Williamson, Rec. Foram. Great Britain, 1858, p. 67, pl. 5, fig. 140.—Seguenza, Atti Accad. Lincei., ser. 3, vol. 6, 1879, pp. 226, 307.—Bütschli, in Bronn, Klassen und Ordnungen Thier-Reichs, vol. 1, 1880, p. 200, pl. 7, fig. 31.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 576, pl. 74, figs. 15–18.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28 (Sci.), 1885, p. 347.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 487.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 314, pl. 9, figs. 40, 46, 47.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 51, pl. 9, figs. 502–509.—Jones, Pal. Soc., 1895, p. 277, pl. 7, fig. 26.—Chapman, Proc. Zool. Soc., London, 1895, p. 35.—Flint, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 320, pl. 68, fig. 3.—Liebus, Neues Jahrb. für Min., vol. 1, 1901, p. 120, pl. 5, fig. 3.—Millett, Journ. Roy. Micr. Soc., 1903, p. 269.—Chapman, Journ. Quekett Micr. Club., ser. 2, vol. 10, 1907, p. 132, pl. 10, fig. 5.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 52, pt. 3, No. 13, 1908, p. 1, pl. 1, fig. 4.—Chapman, Proc. Roy. Soc. Victoria, vol. 22, new series, pt. 2, 1910, p. 281.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 54, pt. 3, No. 16, 1910, p. 23.—Chapman, Journ. Linn. Soc. Zoology, vol. 30, 1910, p. 414.

*Uvigerina pygmaea*, var. *angulosa* Parker and Jones, Philos. Trans., vol. 155, 1865, p. 364, pl. 13, fig. 58; pl. 17, fig. 66.

*Description.*—Test elongate tapering toward either end, composed of numerous chambers, three making each whorl, chambers compressed at two sides making a decided angle in the middle and making up a trifacial test, triangular in end view and section; wall more or less costate, usually the costæ numerous and distinct; aperture with a short tubular neck and with a phialine lip usually more developed on the outer side.

Length 0.5 to 0.85 mm.

*Distribution.*—In general this species appears to be widely distributed. Brady records it from three North Pacific stations in from 50 to 500 fathoms. Flint records it from Panama Bay in 51 fathoms. Bagg records it from numerous stations about the Hawaiian Islands in 104 to 1,342 fathoms. I have had typical material from four *Albatross* stations, H2922 in 268 fathoms near the Hawaiian Islands and D4813, D4818, and D4857 in 200, 225, and 324 fathoms, respectively, off the coast of Japan.

The characters of this species are very distinctive and it is not easily mistaken.

### UVIGERINA ANGULOSA Williamson, var. SPINIPES H. B. Brady.

Plate 43, fig. 3.

*Uvigerina spinipes* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 64.
*Uvigerina angulosa* Williamson, var. *spinipes* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 577, pl. 74, figs. 19, 20.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 315, pl. 9, fig. 59.—Chapman, Proc. Zool. Soc. London, 1895, p. 200.

*Description.*—Test elongate, tapering toward either end, chambers more or less triangular in cross section, early chambers with longitudinal costæ often prolonged into spinose projections at the apical end; later chambers with smooth walls and more loosely arranged; aperture with a tubular neck gradually merging into the outline of the chamber at the proximal end and with a definite phialine lip at the outer end.

Length about 0.75 mm.

*Distribution.*—This variety has not been recorded from the North Pacific. Brady recorded it from off Tristan d'Acunha, Egger from two stations off New Amsterdam and West Australia, and Chapman from the Arabian Sea.

The only North Pacific material I have seen is from *Nero* station 1306, in 1,208 fathoms between Yokohama and Guam. The figured specimen is from this station.

Brady described this as a distinct species and it certainly has but little in common with *U. angulosa* Williamson. With the exception of one of the stations recorded by Chapman and one by Egger, it has not occurred in company with *U. angulosa*, but as these are two from only five stations the percentage is rather large. The spinose condition of the early chambers is also different from what is usually seen in *U. angulosa*.

### UVIGERINA PORRECTA H. B. Brady.

Plate 44, fig. 2.

*Uvigerina porrecta* H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 60, pl. 8, figs. 15, 16; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 577, pl. 74, figs. 21–23.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 315, pl. 9, figs. 51, 63.—Chapman, Journ. Linn. Soc. Zoology, vol. 30, 1910, p. 414.

*Description.*—Test much elongated, early chambers in a close spiral, later ones drawn out and considerably separated from one another; chambers, especially the later ones, concave below, the peripheral edge angular and projecting; upper surface of the chambers convex and ornamented by coarse longitudinal costæ which project at the peripheral edge, making it serrate; aperture with an elongated tubular neck, the lip not well developed.

Length about 0.5 mm.

*Distribution.*—From the known records this species seems to be confined to the region of coral reefs, although it may occur at considerable depths, as shown by Chapman, who records it at 2,400 fathoms off Funafuti. Such records as have already been noted in regard to other coral reef species in this paper may be due to the carrying out of such species into deep water through the action of currents. Brady records this species from north of New Guinea in 1,850 fathoms as the only North Pacific station. I have not seen it from the region of the coral reefs of the Hawaiian Islands nor does Bagg record it from this region. I have found it, however, in material from several *Nero* stations near Guam in 859 to 1,503 fathoms. This material is typical.

There is a considerable variation in the costæ, which in some cases, as shown in figure 2, are only developed on the periphery of the chambers.

### UVIGERINA ACULEATA d'Orbigny.

Plate 43, fig. 4.

*Urigerina aculeata* d'Orbigny, Foram. Foss. Bass. Tert. Vienne, 1846, p. 191, pl. 11, figs. 27, 28.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 578, pl. 75, figs. 1, 2.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 487.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 311, pl. 9, figs. 48, 49.—Chapman, Proc. Zool. Soc. London, 1895, p. 35.—Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 50.—Fornasini, Boll. Soc. Geol. Ital., vol. 25, 1907, p. 348, pl. 4, fig. 1.—Chapman, Journ. Linn. Soc., Zoology, vol. 30, 1910, p. 414.

*Description.*—Test elongate, tapering; chambers numerous, inflated, sutures distinct, even under the ornamentation which in the early chambers is often made up of longitudinal costæ, the later chambers or all in some cases covered with a spinose development, having the appearance in certain specimens of a secondary shell layer, the spines stout, initial end of the test acute, usually with a spine; aperture with a short neck and flaring phialine lip.

Length up to 1.5 mm.

*Distribution.*—This species has been recorded from the North Pacific by Goës, from the west coast of America in 759 to 1,218 fathoms. In the mounted set returned to the United States National Museum by Goës there is but a single specimen of typical *U. aculeata,* the others being *U. pygmæa* and *U. asperula.* In the material which I have examined the typical form of the species shown in the figures has occurred but once, *Albatross* D4957, off Japan, in 437 fathoms, bottom temperature 39.8° F. At *Nero* station 1154, 1,602 fathoms, a specimen was dredged showing this spinose character well developed on the last formed chamber only. This species seems to be more common in the South Pacific.

### UVIGERINA ASPERULA Czjzek.

Plate 43, fig. 1.

*Uvigerina asperula* Czjzek, Haidinger's Nat. Abh., 2, 1848, p. 146, pl. 13, figs. 14, 15.—Reuss, Sitz. kais. Akad. Wiss., Wien, vol. 55, Abth. 1, 1867, p. 93, pl. 4, figs. 6*a*, *b*, 7, 8, 9.—Terrigi, Atti Accad. Port. Nuovi Lincei, vol. 35, 1883, p. 185, pl. 2, fig. 26.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 578, pl. 75, figs. 6–8.—Sherborn and Chapman, Journ. Roy. Micr. Soc., 1886, p. 755, pl. 16, fig. 7.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 225, pl. 45, figs. 4, 5.—Terrigi, Mem. Com. Geol. Italia, vol. 4, 1891, p. 100, pl. 3, fig. 25.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 487.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol, 18, 1893, p. 312, pl. 9, fig. 41.—Chapman, Proc. Zool. Soc. London, 1895, p. 35.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 320, pl. 68, fig. 4.—Millett, Journ. Roy. Micr. Soc., 1903, p. 267.—Chapman, Trans. New Zealand Inst., vol. 38, 1906, p. 99; Journ. Linn. Soc., Zoology, vol. 30, 1910, p. 415.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 150.

*Description.*—Test elongate-ovate, chambers somewhat inflated, sutures distinct but not deep; surface ornamented by a hispid or spinose exterior of much variableness in different specimens, the fine spines either in indefinite longitudinal rows or scattered without a definite arrangement; initial end bluntly rounded or with a distinct stout spine, aperture with a definite tubular neck with a well developed phialine lip.

Length 0.6 to 0.8 mm.

*Distribution.*—From the material examined this seems to be one of the most common species of the genus, having been dredged at many stations in various parts of the North Pacific, from 323 to 1,758 fathoms. It was recorded from between 20 and 40 stations well scattered over the area. The bottom temperature where recorded is in almost all cases between 35° and 36° F.

Brady records this species from three stations in the North Pacific in 345 to 2,300 fathoms, and Bagg records it from 13 *Albatross* stations off the Hawaiian Islands in 275 to 1,544 fathoms.

There is certainly a very considerable difference in the shape and ornamentation of the various forms assigned to this species. Even in the material examined it appears that various modifications can be segregated, and with sufficient material from other areas it would not be difficult to establish definite groups which have in general a hispid ornamentation.

The specimen figured is one of medium coarseness as far as the ornamentation is concerned.

### UVIGERINA AMPULLACEA H. B. Brady.

Plate 42, fig. 3.

*Uvigerina asperula* Czjzek, var. *ampullacea* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 579, pl. 75, figs. 10, 11.—Chapman, Proc. Zool. Soc. London, 1895, p. 35.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 320, pl. 68, fig. 5.—Millett, Journ. Roy. Micr. Soc., 1903, p. 267.—Bagg, Proc, U. S. Nat. Mus., vol. 34, 1908, p. 150.—Chapman, Journ. Linn. Soc., Zoology' vol. 30, 1910, p. 415.

*Uvigerina ampullacea* Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 313, pl. 9, fig. 37.

*Uvigerina auberiana* Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 52, pl. 9, figs. 494, 495.

*Description.*—Test composed in the early portion of a more or less compact spiral of chambers followed by two or more chambers uniserially arranged; surface finely hispid, with pointed aculei; aperture with an elongate neck and narrow rimmed phialine neck.

Length about 1 mm.

*Distribution.*—From the material examined this species is much less common in the North Pacific than *U. asperula*. It has occurred at numerous stations, mainly in the western Pacific and about the Hawaiian Islands. The shallowest station is *Nero* station, 2034, in 175 fathoms, near the Hawaiian Islands, and the deepest is *Nero* station 187, in 2,473 fathoms. Most of the stations had depths of less than 1,500 fathoms. The only stations from which the bottom temperatures are recorded are 35° and 38° F. Bagg records this species from several *Albatross* stations off the Hawaiian Islands in 384 to 1,342 fathoms.

The distribution of *U. ampullacea* and *U. asperula* is not identical in the material examined and the decidedly senescent character of uniserial arrangement of the chambers after the compact growth at the start make it seem that this form is worthy of specific rank.

### UVIGERINA AUBERIANA d'Orbigny.

Plate 37, fig. 5.

*Uvigerina auberiana* d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 106, pl. 2, figs. 23, 24.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 19, No. 4, 1882, p. 60, pl. 4, fig. 75; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 50.

*Uvigerina asperula* Czjzek, var. *auberiana* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 579, pl. 75, fig. 9.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 150.

*Description.*—Test ovate, chambers numerous. The later ones arranged biserially; surface covered with short spines; aperture with a short lip and phialine lip.

Length about 1 mm.

*Distribution.*—Bagg records this species from several *Albatross* stations in the vicinity of the Hawaiian Islands, in 384 to 1,307 fathoms. I have not found North Pacific material which seemed to me definite enough to assign to this species.

D'Orbigny's figure shows a coarsely spinose test with a shape somewhat different from that given by Brady and which is reproduced here.

UVIGERINA AUBERIANA d'Orbigny, forma LÆVIS Goës.

*Uvigerina auberiana* Goës (part), Kongl. Svensk. Vet. Akad. Handl., vol. 19, No. 4, 1882, p. 60, pl. 4, figs. 71–74.

*Uvigerina auberiana* d'Orbigny, forma *lævis* Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 51.

*Description.*—"Our form comes very near to *U. farinosa* Hantken,[1] and is in all respects but for its smooth surface of similar build as the type, the strong relationship of which it shows, even by its earliest segments being provided with a few short spines or warts."

Length about 0.50 to 1 mm.

*Distribution.*—Given by Goës as found in the Eastern Pacific in 600 to 1,201 fathoms.

The above description is copied from Goës. No figure was given.

UVIGERINA INTERRUPTA H. B. Brady.

Plate 44, fig. 1.

*Uvigerina interrupta* H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 60, pl. 8, figs. 17, 18; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 580, pl. 75, figs. 12–14.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 313, pl. 9, fig. 58.—Chapman, Proc. Zool. Soc. London, 1895, p. 34.—Millett, Journ. Roy. Micr. Soc., 1903, p. 268.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 151.—Chapman, Journ. Linn. Soc., Zoology, vol. 30, 1910, p. 415.

*Description.*—Test slender, elongate, loosely spiral, chambers inflated, earlier ones in a more or less compact spire, later ones in an interrupted irregularly spiral series; surface with fine spines, giving a hispid character to the whole test; aperture with an elongated tubular neck and a phialine lip at its termination.

Length about 0.5 mm.

*Distribution.*—In the North Pacific the only records for this species are those given by Bagg, *Albatross* stations H4430, H4440, and H4508, in 1,544, 1,259, and 495 fathoms, respectively. In the material I have examined it has occurred most commonly off Guam and in the region between Guam and southern Japan, about the Hawaiian Islands, and off the Galapagos. The last were much smoother than the usual form. In depth the stations range from

[1] For. Clavul. Szábol Sch., 1875, Separ., pl. 7, fig. 6.

437 to 1,505 fathoms. In temperature there is data but for three stations, 437 fathoms off Japan, 39.8° F.; 1,505 fathoms also off Japan, 35.7° F.; and 1,379 fathoms off the Galapagos, 36.4° F. In general, this species seems to have a tropical distribution running up to southern Japan.

### Genus SIPHOGENERINA Schlumberger, 1883.

*Sagrina* Parker and Jones (not *Sagrina* d'Orbigny), Philos. Trans., vol. 155, 1865, p. 363.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 580.

*Dimorphina* Schwager (not *Dimorphina* d'Orbigny), *Novara* Exped., Geol. Theil., vol. 2, 1866, p. 251.

*Siphogenerina* Schlumberger [type, *S. raphanus* (Parker and Jones), *Uvigerina* (*Sagrina*) *raphanus* Parker and Jones], Feuille des Jeunes Naturalistes, ann. 13, 1883, p. 117.

*Description.*—Test elongate, composed at least in the microspheric form of a series of chambers arranged tri- or biserially, followed by a later uniserial development; walls hyaline and perforate, aperture in the uniserial portion central and terminal, usually with an elongated neck and flaring lip; interior of the chamber with a tubular connection running from the base of the apertural neck to the lip of the aperture below; wall smooth or ornamented by costæ, pits, etc.

This genus is evidently closely related to *Uvigerina*, but seems to be distinct in its uniserial development, which in *Siphogenerina* becomes the major portion. In the megalospheric form the uniserial condition is taken on much earlier than in the microspheric form.

Both genera, *Sagrina* and *Dimorphina*, as used by d'Orbigny, undoubtedly belong to the Textulariidæ, and are not available for use here even as amended by Parker and Jones. Therefore the generic name *Siphogenerina* of Schlumberger is the next available name and is here used.

#### SIPHOGENERINA COLUMELLARIS (H. B. Brady).

Plate 47, figs. 2, 3.

*Sagrina columellaris* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 64; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 581, pl. 75, figs. 15–17.—Chapman, Proc. Zool. Soc. London, 1895, p. 36.—Fornasini, Mem. Accad. Sci. Ist. Bologna, ser. 5, vol. 8, 1900, p. 391, fig. 41.—Millett, Journ. Roy. Micr. Soc., 1903, p. 270, pl. 5, figs. 10, 11.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 151.

*Siphogenerina columellaris* Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 316, pl. 9, figs. 28, 31, 33; vol. 21, 1899, p. 134, pl. 16, figs. 20, 21.—Silvestri, Atti Pont. Accad. Nuovi Lincei, ann. 55, 1902, p. 1, figs. 1, 2.

*Siphogenerina glabra* Schlumberger, Feuille des Jeunes Naturalistes, ann. 13, 1883, p. 118, pl. 3, fig., 1.

*Description.*—Test elongate, subcylindrical, somewhat tapering, straight or very slightly curved; chambers comparatively few; those

of the uniserial portion well rounded, shorter than broad, sutures only slightly constricted; aperture large, terminal, with a very short tubular neck and broad flaring lip; wall smooth.

Length about 1 mm.

*Distribution.*—The only published North Pacific records are those given by Bagg. These are seven *Albatross* stations in the vicinity of the Hawaiian Islands, 104 to 1,544 fathoms. I have found the species fairly common in the region from near the Hawaiian Islands, *Albatross* H2922 in 268 fathoms, *Nero* 2071 in 271 fathoms, and off the coast of Japan, D4968 in 253 fathoms. It has occurred also in the *Nero* material from numerous stations on the line of soundings between Yokohama and Guam in 1,208 to 1,660 fathoms. This species has been found at three *Tuscarora* stations, 57 and 58, in 814 and 1,331 fathoms near the Bonin Islands and at station 15 in 1,874 fathoms south of the Midway Islands. The bottom temperatures where recorded are 44.8° and 45.7° F. off Japan and the Hawaiian Islands, but at the deeper *Nero* soundings go down to 35° F.

### SIPHOGENERINA BIFRONS (H. B. Brady).

Plate 45, figs. 1, 2, 5–7.

*Sagrina bifrons* H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 64; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 582, pl. 75, figs. 18–20.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, 1899, p. 134, pl. 15, figs. 25, 26.—Millett, Journ. Roy. Micr. Soc., 1903, p. 270.—Chapman, Journ. Linn. Soc., Zoology, vol. 30, 1910, p. 415.

*Siphogenerina* (*Sagrina*) *bifrons* Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 317, pl. 9, figs, 25, 26, 29.

*Description.*—Test elongate, compressed, straight or very slightly curved, in end view elliptical, median portions of the broad faces somewhat concave, megalospheric form with the apical end broadly rounded and of about the same diameter as the rest of the test, microspheric form with the apical end much more attenuate, growing rapidly broader, then contracted where the uniserial portion begins; sutures hardly depressed, distinct, often of clear material, appearing darker than the rest of the test; aperture rounded, without a distinct neck but with a slight rounded lip; microspheric form usually the larger.

Length 0.75 to 1 mm.

*Distribution.*—Brady described this species from material dredged in 345 fathoms on the *Hyalonema*-ground off southeastern Japan. This is the only locality noted in the *Challenger* Report. It has been recorded by Egger off west Australia, by Millett from the Malay Archipelago, and by Chapman from about Funafuti. Apparently the species belongs to a warm-water fauna reaching its northern limit off Japan. Egger's material was from 560 fathoms, Millett's material from shallow water, while Chapman's specimens were from 2,400

fathoms, but the occurrence in deep water off oceanic islands has been several times referred to.

In the material which I have examined the species has occurred at several stations off southeastern Japan in the region from which Brady's types came. These stations have depths of from 191 to 500 fathoms. It was also found to be frequent off the Philippines, occurring at *Nero* station 849 in 737 fathoms.

As is usual in other species the microspheric form occurs less frequently than the megalospheric and the latter does not attain as large dimensions. The two may be distinguished at a glance as the megalospheric form, which is represented in all of Brady's figures, is bluntly rounded, the early portion being of about the same diameter as the later developed, uniserial portion. In the microspheric form the early portion is more acute and tapering, the test above being contracted at the beginning of the uniserial portion.

Occasionally specimens of this species show traces of delicate striations.

One point of particular significance is the fact shown in fig. 5, where it may be seen that in the microspheric form there is a tendency toward a spiral development in the earliest chambers. This shows the relationship of this genus to close coiled genera such as *Cristellaria* and its probable development from a close coiled form.

The relation of the interior tubular structure to the walls of the test is diagrammatically shown in fig. 7.

In four cases the bottom temperature is given for the stations at which this species has occurred. They are 39.1°, 44.1°, 45.7°, and 49.4° F. These are all off the coast of Japan, and as will be seen are rather higher than bottom temperatures run as a rule. This may have a definite bearing on the distribution in this species.

**SIPHOGENERINA DIMORPHA (Parker and Jones).**

Plate 45, figs. 3, 4.

*Uvigerina* (*Sagrina*) *dimorpha* PARKER and JONES, Philos. Trans., vol. 155, 1865, p. 420, pl. 18, fig. 18.

*Sagrina dimorpha* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 582, pl. 76, figs. 1–3.—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc. London, vol. 12, 1888, p. 225, pl. 45, fig. 6.—GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 52, pl. 9, figs. 510, 511.—BAGG, Bull. U. S. Nat. Mus., vol. 34, 1908, p. 152.

*Siphogenerina dimorpha* EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 317, pl. 9, fig. 30.

*Description.*—Test nearly cylindrical, elongate, slightly tapering, usually broadest near the apertural end, chambers comparatively few, broader than long, slightly inflated; sutures distinct, usually somewhat excavated at nearly regular intervals, the portions between extended backward and bridging over the suture; walls with

comparatively large pitted depressions or perforations; aperture circular with a very short neck and flaring lip.

Length 0.5 to 0.8 mm.

*Distribution.*—Bagg records this species from three *Albatross* stations in the vicinity of the Hawaiian Islands, in 572 to 1,259 fathoms. In the same region it occurs at *Albatross* station H3007 in 323 fathoms. In the western Pacific it has occurred off the coast of Japan, *Albatross* station D4957 in 437 fathoms. It also occurred at *Nero* stations 1306 and 1311 in 1,208 and 1,503 fathoms and at two *Tuscarora* stations 47 and 58 in 1,499 and 814 fathoms. These last four stations are not far from the Bonin Islands. At D4957 the bottom temperature was 39.8°, but it is not recorded from the other stations.

This species is more widely distributed than others of the genus, both in depth and area. It is characteristic in its appearance and can easily be distinguished.

Goës [1] refers to this species a form which is evidently a *Clavulina*, as his figures and description show. Later he figured a specimen in his work on the Scandinavian Foraminifera [2] which very clearly belongs to this species.

The interior has the characteristic tubular structure as shown in fig. 4, *c*.

### SIPHOGENERINA STRIATA (Schwager).

Plate 47, figs. 4, 5.

*Dimorphina striata* Schwager, *Novara* Exped., Geol. Theil., vol. 2, 1866, p. 251, pl. 7, fig. 99.

*Sagraina striata* Schwager, Bull. Comm. geol. Ital., vol. 8, 1877, p. 25, pl., fig. 35.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1894, p. 584, pl. 75, figs. 25, 26.—Millett, Journ. Roy. Micr. Soc., 1903, p. 272.

*Siphogenerina* (*Sagrina*) *striata* Egger [?], Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 316, pl. 9, figs. 32, 34, 35, 64, 65.

*Description.*—Test elongate, cylindrical, chambers of the uniserial portion broader than long, sutures not deep but conspicuous, wall ornamented by longitudinal costæ, not close together and not high; aperture circular with no neck but a prominent rounded lip.

Length 0.75 to 1 mm.

*Distribution.*—Brady records this species at one North Pacific station off the Philippines in 95 fathoms. I have found specimens from the vicinity of the Hawaiian Islands, *Nero* station 2035, in 114 fathoms, *Nero* Station 1466, off Guam, 234 fathoms, and a specimen which can be referred here from *Nero* station 1321, southeast of the Bonin Islands in 1,618 fathoms.

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[1] Kongl. Svensk. Vet. Akad. Handl., vol. 19, No. 4, 1882, p. 62, pl. 4, figs. 77–81.

[2] Idem, vol. 25, No. 9, 1894, pl. 9, figs. 510, 511.

From the original figure given by Schwager this recent form would seem to be distinct in the large aperture which is without a neck, the chambers low and broad, while the figure given by Schwager shows a typical *Uvigerina* aperture, the neck long and slender and the chambers as long as broad and much more inflated. I am inclined to think that our recent species figured here is distinct, but more material is necessary to establish this view.

SIPHOGENERINA RAPHANUS (Parker and Jones).

Plate 46, figs. 1–5.

*Uvigerina* (*Sagrina*) *raphanus* PARKER and JONES, Philos. Trans., vol. 155, 1865, p. 364, pl. 18, figs. 16, 17.

*Sagrina raphanus* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 585, pl. 75, figs. 21–24.—MILLETT, Journ. Roy. Micr. Soc., 1903, p. 272.—CHAPMAN, Journ. Linn. Soc., Zoology, vol. 30, 1910, p. 415.

*Siphogenerina* (*Sagrina*) *raphanus* EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 317, pl. 9, fig. 36.

*Siphogenerina costata* SCHLUMBERGER, Feuille des Jeunes Naturalistes, ann. 13, 1883, p. 118, fig. 13.

*Description.*—Test elongate, cylindrical, or tapering, chambers of the uniserial portion broader than long; surface marked by several rather widely separated, well-developed costæ, each extending nearly the length of the test and not affected by the sutures; aperture typically with a short tubular neck and well-developed flaring lip.

Length 0.5 to 1 mm.

*Distribution.*—Brady records the occurrence of this species from off the Philippines in 95 fathoms, off the coral reefs of Honolulu, Hawaiian Islands, in 40 fathoms and in the volume of the *Challenger* "Report on the Summary of Results," from station 232 in 345 fathoms on the *Hyalonema*-ground southeast of Japan. I have material from *Albatross* stations off Japan in this same region, D4916 in 361 fathoms and D4807 in 44 fathoms. It occurs also at *Nero* station 1306, between Yokohama and Guam, in 1,208 fathoms, and *Nero* station 2071 in 271 fathoms near the Hawaiian Islands. The only temperature records are from D4916, where the bottom temperature was 42.7°.

Both megalospheric and microspheric specimens were seen and figured by Brady, who notes the much larger size of the latter. The form, too, is different, the microspheric form being much more tapering.

SIPHOGENERINA STRIATULA, new species.

Plate 47, fig. 1.

*Description.*—Test elongate, subcylindrical; chambers for the most part broader than long, but the terminal one nearly as long as broad; sutures slightly indented; surface ornamented with fine longitudinal striæ; aperture narrowly elongate, without a neck, but a well-developed lip present.

Length about 1 mm.

*Distribution.*—This species has occurred at numerous stations in the region between Yokohama and Guam, depths ranging from 859 fathoms to 1,660 fathoms. Type, Cat. No. 8552, U.S.N.M., from *Nero* station 1472 in 1,000 fathoms. No bottom temperatures are recorded for any of the stations at which this species has occurred, but where they are given from adjacent stations they are below 40° F.

The fine striate surface and the form of the aperture will serve to distinguish this species.

SIPHOGENERINA IRREGULARIS (Bagg).

Plate 47, figs. 6, 7.

*Sagraina irregularis* Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 152, pl. 5, figs. 8–10.

*Description.*—Test elongate, subcylindrical; chambers somewhat irregular, but becoming uniserial in the later developed portion; variable as regards height of individual chambers; surface ornamented with very fine costæ; wall thin and translucent, apertural end of the chamber depressed; aperture slightly excentric, with a long tubular neck and a slightly flaring lip.

Length 0.75 to 1.50 mm.

*Distribution.*—Bagg described this species from *Albatross* material dredged near the Hawaiian Islands, D4025 in 275 to 368 fathoms and H4571 in 384 fathoms. I have found the species at four stations in this same region, *Albatross* H2922, H2923, and H2986 in 268, 392, and 271 fathoms. It also occurred at *Nero* station 2071, in 271 fathoms. But one station, H2922, has the bottom temperature recorded, this being 44.8° F. However, the adjacent station to H2986 at nearly the same depth has a recorded temperature of 48.1° F. Evidently this species is a somewhat local one, but is to be watched for elsewhere under similar conditions. This belongs to *Siphogenerina*, as is shown by the figure of the interior, fig. 7.

There is a specimen from *Nero* station 166 in 1,850 fathoms northeast of Midway Island, which has many of the characteristics of this species, but the costæ are much coarser. It may be a deep-water form of this species. Bagg speaks of this species as resembling *S. striata* (Schwager), but it much more closely resembles the figure given by Schwager[1] and named by him *Uvigerina nitidula*.

SIPHOGENERINA (?) ANNULATA (H. B. Brady).

Plate 37, figs. 8, 9.

*Sagrina* (?) *annulata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 586, pl. 76, figs. 20, 21.

*Description.*—"Test subcylindrical; oral end rounded, aboral extremity obtusely angular or rounded; composed of few (two to four), elongate, somewhat inflated segments, united end to end. Surface

[1] *Novara* Exped., Geol. Theil, vol 2, 1867, pl. 7, fig 93.

marked by closely set, slightly depressed, transverse lines. Aperture a simple terminal rounded orifice."

"Length $\frac{1}{35}$ inch (0.75 mm.)."

*Distribution.*—Described by Brady from material dredged from Honolulu coral reefs in 40 fathoms.

The description and figures are from Brady. He questions whether or not the species may be a *Sagrina* and until further material may be found its affinities can not clearly be determined.

### Subfamily 5. RAMULININÆ.

Test composed of branching tubular masses with rounded chamber-like portions at irregular intervals.

### Genus RAMULINA Rupert-Jones, 1875.

*Ramulina* Rupert-Jones (type, *R. lævis* Rupert-Jones) in Wright, Rep. Proc. Belfast Nat. Field Club, 1873–74, App. III, 1875, p. 88 [90].

*Description.*—Test free, branching, consisting of more or less round chambers connected by long stoloniferous tubes; wall hyaline.

This genus includes rather ill-defined forms, suggesting the so-called "wild growth" seen in the final chambers of certain species of *Polymorphina*. Just what its relations are to the rest of the Lagenidæ is not really determined. It seems to occur in the Cretaceous and there are one or two recent species.

#### RAMULINA GLOBULIFERA H. B. Brady.

Plate 39, fig. 1.

*Ramulina globulifera* H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 58, pl. 8, figs. 32, 33; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 587, pl. 76, figs. 22–28.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 310, pl. 9, fig. 62.—De Amicis, Naturalista Siciliano, ann. 14, 1895, p. 112, pl. 1, fig. 14.—Chapman, Proc. Zool. Soc. London, 1895, p. 36; Journ. Roy. Micr. Soc. 1896, p. 582, pl. 12, figs. 3–6.—Jones and Chapman, Journ. Linn. Soc. Zool., vol. 26, 1897, p. 340, figs. 5–22.—Egger, Abh. kön. bay. Acad. Wiss. München, Cl. II, vol. 21, 1899, p. 135, pl. 2, fig. 2, pl. 22, fig. 33.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 321, pl. 68, fig. 6.—Millett, Journ. Roy. Micr. Soc. 1903, p. 274.—Benham, Trans. New Zealand Inst., vol. 37, 1904 (1905), p. 300.—Chapman, Trans. New Zealand Inst., vol. 38, 1905 (1906), p. 99.

*Description.*—Test free, branching, composed of nearly globular chambers connected by stolon-like tubes; wall hyaline, usually hispid; apertures tubular, often several to a single chamber.

Length up to nearly 2 mm.

*Distribution.*—Brady records the species from a single *Challenger* station off the Philippines in 95 fathoms. I have had specimens from *Albatross* station D4949, off Japan, in 110 fathoms.

## EXPLANATION OF PLATES.

### Plate 1.

Fig. 1. *Lagena lateralis.* × 125. *a*, front view by transmitted light; *b*, apertural view; *c*, front view; *d*, side view.
2. *Lagena collaris.* × 125. *a*, front view; *b*, same by transmitted light; *c*, apertural view.
3. *Lagena lævis.* × 65. *a*, front view; *b*, side view; *c*, apertural view.
4. *Lagena gracillima.* × 65. *a*, front view; *b*, apertural view.
5. *Lagena elongata.* × 35. *a*, front view; *b*, apertural view.

### Plate 2.

Fig. 1. *Lagena lævigata.* × 65. *a*, front view; *b*, apertural view; *c*, front view by transmitted light.
2. *Lagena ovum.* × 125. *a*, front view; *b*, same by transmitted light; *c*, apertural view.
3. *Lagena clavata.* × 125. *a*, front view; *b*, apertural view.

### Plate 3.

Figs. 1–3. *Lagena sacculus.* 1. Form with slight development of keel × 65. *a*, apertural view; *b*, front view; *c*, same by transmitted light.
2. Form with medium keel × 65. *a*, apertural view; *b*, front view; *c*, same by transmitted light.
3. Form with broad keel × 125. *a*, apertural view; *b*, front view; *c*, same by transmitted light.

### Plate 4.

Fig. 1. *Lagena felsinea.* × 75. *a*, front view; *b*, same by transmitted light; *c*, apertural view.
2. *Lagena globosa.* *a*, front view, × 75; *b*, apertural view, × 75; *c*, optical section, × 40.
3. *Lagena ampulla-distoma*, var. *cribrostomoides.* *a*, front view, × 90; *b*, basal view, × 90; *c*, view of aperture, × 300.
4. *Lagena hispida.* × 150. *a*, front view; *b*, apertural view.
5. *Lagena hispida.* × 90. *a*, front view; *b*, apertural view.

### Plate 5.

Fig. 1. *Lagena hispida.* × 90.
2. *Lagena hispidula.* × 90. *a*, front view; *b*, apertural view.
3. *Lagena hispidula.* × 90.
4. *Lagena punctulata.* *a*, front view, × 90; *b*, apertural view, × 90; *c*, portion of surface, × 300.
5. *Lagena hystrix.* *a*, front view, × 90; *b*, apertural view, × 90; *c*, portion of surface, × 300.

### Plate 6.

Fig. 1. *Lagena squamosa.* × 125. *a*, front view; *b*, apertural view.
2. *Lagena hexagona.* × 65. *a*, front view, *b*, apertural view in outline; *c*, detail of aperture.
3. *Lagena hexagona.* × 125. *a*, front view; *b*, apertural view in outline.
4. *Lagena hexagona*, var. *scalariformis.* × 125.

PLATE 7.

Fig. 1. *Lagena catenulata.* × 150. *a*, front view; *b*, apertural view.
2. *Lagena catenulata.* × 75.
3. *Lagena foveolata.* × 75. *a*, front view; *b*, apertural view.
4. *Lagena striata.* × 75.
5. *Lagena striata.* × 75.
6. *Lagena striata*, var. *haidingeri.* × 75. *a*, front view; *b*, apertural view.
7. *Lagena striata*, var. *strumosa.* × 90.
8. *Lagena striata*, var. *strumosa.* × 90.
9. *Lagena striata*, var. *strumosa*, neck. × 150.
10. *Lagena striata*, var. *strumosa*, neck. × 150.

PLATE 8.

Fig. 1. *Lagena striata*, var. *substriata*, elongate form. × 150. *a*, front view; *b*, apertural view.
2. *Lagena striata*, var. *substriata.* × 150.
3. *Lagena striata*, var. *substriata.* × 180. Apertural portion of unbroken specimen showing spiral ornamentation of neck.
4. *Lagena mucronulata.* × 75.
5. *Lagena gracilis.* × 75. *a*, front view; *b*, apertural view.
6. *Lagana gracilis*, neck. × 150.
7. *Lagena gracilis*, var. × 150.
8. *Lagena inferocostata.* × 75. *a*, front view; *b*, apertural view; *c*, basal view.
9. *Lagena acuticosta.* × 75. *a*, front view; *b*, apertural view.
10. *Lagena acuticosta.* × 75.

PLATE 9.

Fig. 1. *Lagena acuticosta*, var. *paucicostata.* × 75. *a*, front view; *b*, apertural view.
2. *Lagena sulcata.* × 75.
3. *Lagena sulcata*, var. *apiculata.* × 75. *a*, front view; *b*, apertural view.
4. *Lagena sulcata*, var. *apiculata.* × 90.
5. *Lagena sulcata*, var. *alticostata.* × 75. *a*, front view; *b*, apertural view.
6. *Lagena costata.* × 75.

PLATE 10.

Fig. 1. *Lagena costata.* × 45. *a*, front view; *b*, same by transmitted light; *c*, apertural view.
2. *Lagena costata*, var. *amphora.* × 150.
3. *Lagena costata*, var. *amphora.* × 75.
4. *Lagena costata*, var. *polygonata.* × 90. *a*, front view; *b*, apertural view.

PLATE 11.

Fig. 1. *Lagena unguiculata.* × 60.
2. *Lagena seminiformis.* × 45.
3. *Lagena torquata.* × 75.
4. *Lagena orbignyana*, var. *clathrata.* × 75.
5. *Lagena favoso-punctata.* × 75.
6. *Lagena formosa.* × 50.
7. *Lagena formosa*, var. *favosa.* × 60.
8. *Lagena formosa*, var. *comata.* × 75.

PLATE 12.

Fig. 1. *Lagena costata*, oval form. × 90. *a*, front view; b, apertural view.
2. *Lagena costata*, var. *amphora*. × 90. *a*, front view; *b*, apertural view.
3. *Lagena stelligera*. × 75. *a*, front view; *b*, apertural view; *c*, basal view.
4. *Lagena plumigera*. × 75. *a*, front view; *b*, apertural view.
5. *Lagena desmophora*. × 90. *a*, front view; *b*, apertural view.

PLATE 13.

Fig. 1. *Lagena distoma*. × 75. *a*, front view; *b*, apertural view.
2. *Lagena distoma*. × 75. *a*, front view; *b*, apertural view.
3. *Lagena desmophora*. × 75. *a*, front view; *b*, apertural view.
4. *Lagena intermedia*. × 90. *a*, front view; *b*, apertural view.
5. *Lagena exsculpta*. × 35. *a*, front view; *b*, apertural view.

PLATE 14.

Fig. 1. *Lagena quadricostulata*. × 75.
2. *Lagena auriculata*, var. *costata*. × 60. *a*, front view; *b*, apertural view.
3. *Lagena trigono-marginata*. × 100. *a*, front view; *b*, apertural view.
4. *Lagena trigono-marginata*. × 100.
5. *Lagena striato-areolata*. × 100.
6. *Lagena striato-areolata*. × 100. Portion of the surface.
7. *Lagena ampulla-distoma*. × 60.
8. *Lagena fimbriata*. × 60.
9. *Lagena quadrata*. × 75.
10. *Lagena striato-punctata*. × 75.

PLATE 15.

Fig. 1. *Lagena feildeniana*. *a*, front view, × 150; *b*, apertural view, × 150; *c*, portion of surface enlarged, × 375.
2. *Lagena feildeniana*. × 150. Specimen with wider intercostal areas and higher, more acute costæ. *a*, front view; *b*, apertural view.
3. *Lagena foveolata*, var. *paradoxa*. *a*, front view, × 75; *b*, enlarged portion of surface, × 150.

PLATE 16.

Fig. 1. *Lagena aspera*. × 90.
2. *Lagena lagenoides*. × 150.
3. *Lagena lagenoides*, var. *tenuistriata*. × 150. *a*, front view; *b*, side view.
4. *Lagena sublagenoides*. × 75. *a*, front view; *b*, apertural view.
5. *Lagena sublagenoides*, var. *striatula*. × 75.

PLATE 17.

Fig. 1. *Lagena crescenticostata*. × 75. *a*, front view; *b*, side view.
2. *Lagena crescenticostata*. × 75. Specimen with more simple ornamentation.
3. *Lagena staphyllearia*. × 45. *a*, front view; *b*, apertural view.
4. *Lagena auriculata*, var. *subcarinata*. × 150. *a*, front view; *b*, side view.
5. *Lagena auriculata*, var. *linearituba*. × 75. *a*, front view; *b*, side view.

PLATE 18.

Fig. 1. *Lagena alveolata*. × 75. *a*, front view; *b*, side view.
2. *Lagena alveolata*, var. *plebeia*. × 90. *a*, front view; *b*, side view.
3. *Lagena alveolata*, var. *prolongata*. × 75.
4. *Lagena alveolata*, var. *basiexcavata*. × 75.
5. *Lagena alveolata*, var. *substriata*. × 75.

PLATE 19.

Fig. 1. *Lagena orbignyana.* × 90. *a*, front view; *b*, apertural view.
2. *Lagena orbignyana*, var. *concentrica.* × 90. *a*, front view; *b*, side view.
3. *Lagena truncata.* × 45. *a*, front view; *b*, same by transmitted light; *c*, side view; *d*, apertural view.
4. *Lagena quadrata*, var. *rizzæ.* × 75.

PLATE 20.

Fig. 1. *Lagena orbignyana*, var. *lacunata.* × 150. *a*, front view; *b*, apertural view.
2. *Lagena orbignyana*, var. *crenulata.* × 150. *a*, front view; *b*, apertural view.
3. *Lagena orbignyana*, var. *coronata.* × 45. *a*, front view; *b*, side view.

PLATE 21.

Fig. 1. *Lagena fasciata*, var. *carinata.* × 133. *a*, front view; *b*, apertural view.
2. *Lagena marginata*, var. × 65. *a*, front view; *b*, apertural view.
3. *Lagena marginata*, var. × 65. *a*, front view; *b*, side view.
4. *Lagena apiculata.* × 45. *a*, front view; *b*, side view.

PLATE 22.

Fig. 1. *Lagena marginata.* × 133. *a*, front view; *b*, apertural view.
2. *Lagena marginata.* × 133. *a*, front view; *b*, apertural view.
3. *Lagena marginata.* × 133. Specimen by transmitted light.
4. *Lagena marginata.* × 133. Specimen with broad keel.
5. *Lagena marginata.* × 65. Specimen with keel resembling *L. lagenoides.*
6. *Lagena marginata.* × 65. Specimen with narrow keel by transmitted light.
7. *Lagena marginata.* × 65. Specimen showing irregularly striate surface.

PLATE 23.

Fig. 1. *Lagena orbignyana*, var. *alata.* × 150.
2. *Lagena acuticosta.* × 75. *a*, front view; *b*, apertural view.
3. *Marginulina glabra.* × 40. *a*, front view; *b*, apertural view.
4. *Marginulina striatula.* × 40. *a*, front view; *b*, side view; *c*, apertural view.
5. *Frondicularia bradyi.* × 75. *a*, front view; *b*, apertural view.

PLATE 24.

Fig. 1. *Nodosaria (Glandulina) laevigata.* × 30. Specimen with twin spines at base.
2. *Nodosaria (Glandulina) laevigata.* × 30. *a*, front view; *b*, view of aperture.
3. *Nodosaria mucronata.* × 30. Outline.
4. *Nodosaria roemeri.* × 65. *a*, front view; *b*, apertural view.
5. *Nodosaria roemeri.* × 65. *a*, front view; *b*, apertural view.
6. *Nodosaria roemeri.* × 65. Two-chambered stage.
7. *Nodosaria scalaris.* × 40. *a*, front view; *b*, apertural view.

PLATE 25.

Fig. 1. *Nodosaria inflexa.* × 75.
2. *Nodosaria mucronata.* × 40. *a*, front view; *b*, apertural view.
3. *Nodosaria catenulata.* × 75. *a*, front view; *b*, same by transmitted light; *c*, apertural view.
4. *Nodosaria haueriana.* × 75. *a*, front view; *b*, apertural view.
5. *Nodosaria obliqua.* × 15. *a*, front view; *b*, apertural view.
6. *Nodosaria calomorpha.* × 75. *a*, front view; *b*, outline of same by transmitted light; *c*, apertural view.
7. *Nodosaria pauperata.* × 40. *a*, front view; *b*, apertural view.

PLATE 26.

Figs. 1–3. *Nodosaria pyrula.* × 30–40. 1*a*, front view; 1*b*, apertural view.
4–8. *Nodosaria pyrula*, var. *semirugosa.* Fig. 6, × 30. Others, × 15.
9–11. *Nodosaria soluta.* × 12. 10*a*, front view; 10*b*, apertural view.
12, 13. *Nodosaria raphanus.* × 15. 13*a*, front view; 13*b*, apertural view.

PLATE 27.

Fig. 1. *Nodosaria filiformis.* × 65. Outline by transmitted light.
2. *Nodosaria filiformis.* × 65.
3. *Nodosaria filiformis.* × 33. *a*, front view; *b*, apertural view.
4. *Nodosaria filiformis.* × 33. *a*, front view; *b*, same by transmitted light.
5. *Nodosaria mucronata.* × 65. *a*, front view; *b*, apertural view.
6. *Nodosaria mucronata.* × 65. Outline of chambers by transmitted light.
7. *Nodosaria mucronata.* × 65. Outlines of chambers.
8. *Nodosaria longirostrata.* *a*, front view of last two chambers × 33; *b*, apertural end × 133.
9. *Nodosaria consobrina*, var. *emaciata.* × 16. *a*, front view; *b*, apertural view.

PLATE 28.

Fig. 1. *Nodosaria communis.* × 20. *a*, front view; *b*, apertural view.
2. *Nodosaria communis.* × 33. Outline of chambers.
3. *Nodosaria hirsuta.* × 65.
4. *Nodosaria japonica.* *a*, front view, × 12; *b*, last-formed chamber, × 50; *c*, apertural view, × 50.
5. *Nodosaria simplex.* × 33. *a*, front view; *b*, apertural view.
6. *Nodosaria* (*Glandulina*) *rotundata.* × 33. *a*, front view; *b*, apertural view.
7. *Nodosaria abyssorum.* × 33. *a*, front view; *b*, apertural view.

PLATE 29.

Fig. 1. *Frondicularia robusta*, var. *repanda.* × 30. *a*, front view; *b*, apertural view.
2. *Frondicularia robusta*, var. *repanda.* × 30. A more irregular specimen.
3. *Lingulina carinata.* × 20. *a*, front view; *b*, apertural view.
4. *Cristellaria cultrata.* × 25. *a*, side view; *b*, face view.
5. *Cristellaria crepidula.* × 90. Outline of chambers.
6. *Cristellaria crepidula.* × 60. Outline of chambers.

PLATE 30.

Fig. 1. *Vaginulina protumida.* × 30.
2. *Polymorphina ovata.* × 25. *a*, front view; *b*, apertural view.
3. *Polymorphina sororia.* × 75. *a*, front view; *b*, apertural view.
4. *Cristellaria reniformis.* × 35. *a*, side view; *b*, face view.
5. *Cristellaria subalata.* × 25. Side view.
6. *Cristellaria subalata.* × 60. Basal wing.
7. *Cristellaria subalata.* × 60. Basal wing, × 60.

PLATE 31.

Fig. 1. *Cristellaria articulata.* × 30. *a*, side view; *b*, face view.
2. *Cristellaria crepidula.* × 60.
3. *Cristellaria crepidula.* × 30. *a*, face view; *b*, side view.
4. *Cristellaria crepidula.* × 60. Outline of chambers.
5. *Cristellaria crepidula.* × 150. Outlines of chambers by transmitted light.

PLATE 32.

Fig. 1. *Nodosaria vertebralis*. × 15.
2. *Cristellaria nitida*. × 30. *a*, side view; *b*, face view.
3. *Cristellaria vortex*. × 30. *a*, side view; *b*, face view.
4. *Cristellaria calcar*. × 35.
5. *Frondicularia robusta*. × 17.
6. *Frondicularia robusta*. × 75. *a*, front view; *b*, apertural view.
7. *Vaginulina patens*. × 75. *a*, side view; *b*, face view.
8. *Vaginulina patens*. × 75.

PLATE 33.

Fig. 1. *Cristellaria reniformis*. × 30. *a*, side view; *b*, face view.
2. *Cristellaria tricarinella*, var. *spinipes*. × 30. *a*, side view; *b*, face view.
3. *Cristellaria italica*. × 30. *a*, side view; *b*, face view.
4. *Cristellaria wetherellii*, var. *sublineata*. × 18. *a*, side view; *b*, face view.

PLATE 34.

Fig. 1. *Cristellaria tricarinella*. × 50. *a*, side view; *b*, face view.
2. *Cristellaria tricarinella*. × 50.
3. *Cristellaria convergens*. × 50. *a*, side view; *b*, face view.
4. *Cristellaria costata*. × 35.
5. *Cristellaria echinata*. × 20.
6. *Cristellaria mamilligera*. × 20. *a*, side view; *b*, face view.
7. *Cristellaria gemmata*. × 35. *a*, side view; *b*, face view.
8. *Polymorphina lactea*. × 50.

PLATE 35.

Fig. 1. *Cristellaria gibba*. × 40. *a*, side view; *b*, face view.
2. *Cristellaria acutauricularis*. × 133. *a*, side view; *b*, face view.
3. *Cristellaria rotulata*. × 20. *a*, side view; *b*, face view.
4. *Cristellaria lata*. × 80. *a*, side view; *b*, face view.
5. *Nodosaria guttifera*. × 33. *a*, front view; *b*, apertural view.
6. *Nodosaria mucronata*. × 65. *a*, front view; *b*, side view, abnormal specimen.

PLATE 36.

Fig. 1. *Cristellaria variabilis*. × 65. *a*, side view; *b*, face view.
2. *Cristellaria variabilis*. × 80. *a*, side view; *b*, apertural view.
3. *Cristellaria variabilis*. × 65. Young specimen.
4. *Cristellaria orbicularis*. × 65. *a*, side view; *b*, face view.
5. *Cristellaria orbicularis*. × 65. *a*, side view; *b*, face view.
6. *Cristellaria schloenbachi*. × 50. *a*, side view; *b*, apertural view.
7. *Cristellaria elegantissima*. × 33. *a*, side view; *b*, face view.

PLATE 37.

Fig. 1. *Cristellaria denticulifera*. × 20.
2. *Cristellaria papillosa*. × 20.
3. *Uvigerina schwageri*. × 30. *a*, front view; *b*, apertural view.
4. *Uvigerina schwageri*. × 30.
5. *Uvigerina auberiana*. × 40.
6. *Polymorphina oblonga*. × 40. *a*, front view; *b*, apertural view.
7. *Polymorphina communis*. × 50.
8. *Siphogenerina annulata*. × 60. *a*, front view; *b*, apertural view.
9. *Siphogenerina annulata*. × 100. Last chamber.

PLATE 38.

Fig. 1. *Polymorphina elegantissima.* × 33. *a*, front view; *b*, side view; *c*, apertural view.
2. *Cristellaria latifrons.* × 80. *a*, side view; *b*, face view.
3. *Cristellaria* sp. × 33. *a*, side view; *b*, face view.
4. *Cristellaria* sp. × 33. *a*, side view; *b*, face view.
5. *Lagena lævis.* × 133.
6. *Lagena acuta.* × 100. *a*, front view; *b*, same by transmitted light; *c*, apertural view.

PLATE 39.

Fig. 1. *Ramulina globulifera.* × 33. *a*, elongated specimen; *b*, globular portion.
2. *Triplasia tricarinata.* × 80. *a*, specimen with irregular contour; *b*, specimen with regular contour; *c*, apertural view.
3. *Triplasia reussii.* × 65. *a*, side view; *b*, apertural view.
4. *Vaginulina legumen.* × 33. *a*, side view; *b*, apertural view.
5. *Frondicularia bradyi.* × 160. Specimen by transmitted light showing very thick proloculum with radiating tubes.
6. *Polymorphina angusta.* × 65. *a*, side view; *b*, front view; *c*, rear view; *d*, apertural view.

PLATE 40.

Fig. 1. *Polymorphina rotundata.* × 30. *a*, front view; *b*, side view; *c*, apertural view.
2. *Polymorphina lanceolata.* × 60. *a*, front view; *b*, apertural view.
3. *Polymorphina compressa.* × 30. *a*, front view; *b*, apertural view.
4. *Polymorphina ovata*, fistulose form. × 60. *a*, ventral view; *b*, apertural view; *c*, dorsal view.

PLATE 41.

Fig. 1. *Polymorphina longicollis.* × 65. *a*, front view; *b*, apertural view; *c*, side view.
2. *Polymorphina longicollis.* × 65. *a*, front view; *b*, side view.
3. *Polymorphina longicollis*, fistulose form. × 33. *a*, front view; *b*, apertural view.
4. *Polymorphina gibba.* × 33. *a*, front view; *b*, apertural view.
5. *Polymorphina amygdaloides.* × 80. *a*, front view; *b*, apertural view.
6. *Polymorphina regina.* × 65. Young specimen.
7. *Polymorphina regina.* × 65. *a*, front view; *b*, apertural view.
8. *Polymorphina lactea*, var. *diffusa.* × 33. *a*, front view; *b*, apertural view.

PLATE 42.

Fig. 1. *Uvigerina pygmæa.* × 60. *a*, front view; *b*, apertural view.
2. *Uvigerina proboscidea.* × 60. *a*, front view; *b*, apertural view.
3. *Uvigerina ampullacea.* × 30. *a*, front view; *b*, side view.
4. *Uvigerina tenuistriata.* × 60. *a*, front view; *b*, apertural view.
5. *Uvigerina selseyensis.* × 120. *a*, front view; *b*, apertural view.
6. *Uvigerina canariensis.* × 60. *a*, front view; *b*, side view; *c*, apertural view.

PLATE 43.

Fig. 1. *Uvigerina asperula.* × 65. *a*, front view; *b*, apertural view.
2. *Uvigerina brunnensis.* × 65. *a*, front view; *b*, side view; *c*, apertural view.
3. *Uvigerina angulosa*, var. *spinipes.* × 65. *a*, front view; *b*, apertural view.
4. *Uvigerina aculeata.* × 33. *a*, front view; *b*, side view; *c*, apertural view.
5. *Uvigerina striata.* × 65. *a*, front view; *b*, apertural view.

PLATE 44.

Fig. 1. *Uvigerina interrupta.* × 75. *a*, front view; *b*, side view; *c*, apertural view.
2. *Uvigerina porrecta.* × 75. *a*, front view; *b*, front view; *c*, apertural view, a more attenuate specimen.
3. *Uvigerina striatula.* × 75. *a*, front view; *b*, side view; *c*, apertural view.
4. *Uvigerina angulosa.* × 75. *a*, front view; *b*, side view; *c*, apertural view.
5. *Uvigerina pygmæa.* × 75.

PLATE 45.

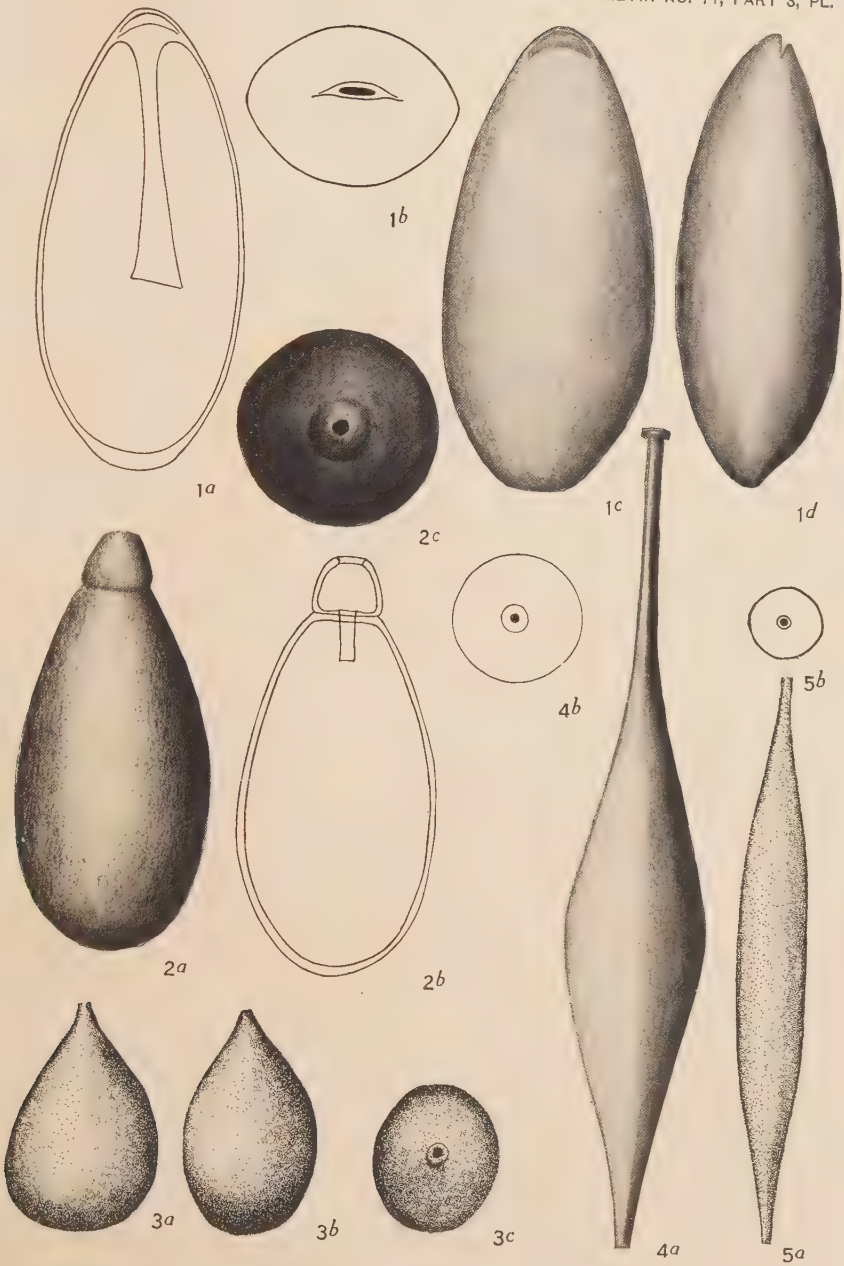
Fig. 1. *Siphogenerina bifrons.* × 75. *a*, front view; *b*, apertural view, microspheric specimen.
2. *Siphogenerina bifrons.* × 75. Megalospheric specimen.
3. *Siphogenerina dimorpha.* × 75. *a*, front view; *b*, apertural view.
4. *Siphogenerina dimorpha.* × 150. Later chambers by transmitted light.
5. *Siphogenerina bifrons.* × 300. Outline of early chamber of microspheric specimen.
6. *Siphogenerina bifrons.* × 75. Outline of megalospheric specimen by transmitted light.
7. *Siphogenerina bifrons.* × 300. Later chambers by transmitted light.

PLATE 46.

Fig. 1. *Siphogenerina raphanus.* × 40. Megalospheric specimen.
2. *Siphogenerina raphanus.* × 40. *a*, front view; *b*, apertural view, microspheric specimen.
3. *Siphogenerina raphanus.* × 225. Outline of early chambers of microspheric specimen.
4. *Siphogenerina raphanus.* × 75. Outline of megalospheric specimen.
5. *Siphogenerina raphanus.* × 75. Later chambers by transmitted light.

PLATE 47.

Fig. 1. *Siphogenerina striatula.* × 75. *a*, front view; *b*, apertural view.
2. *Siphogenerina columellaris.* × 75. *a*, front view; *b*, apertural view.
3. *Siphogenerina columellaris.* × 75. Specimen by transmitted light.
4. *Siphogenerina striata.* × 75. *a*, front view; *b*, apertural view.
5. *Siphogenerina striata.* × 75. Later chambers by transmitted light.
6. *Siphogenerina irregularis.* × 75. *a*, front view; *b*, apertural view.
7. *Siphogenerina irregularis.* × 75. Later chambers by transmitted light.

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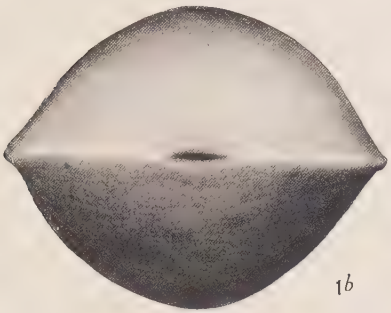

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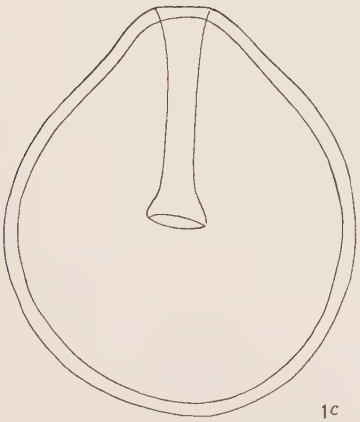

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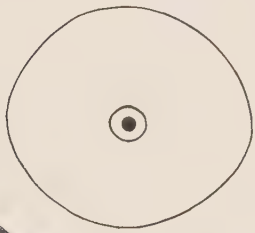

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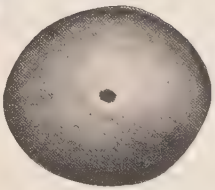

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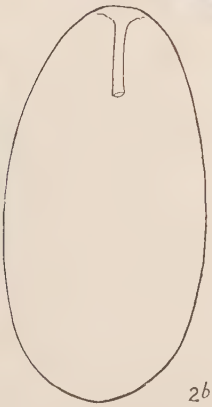

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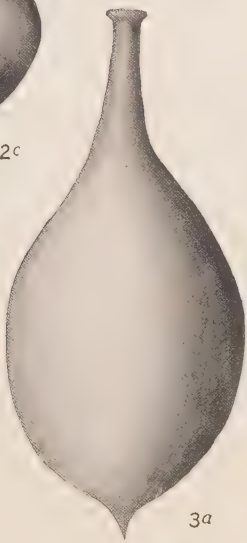

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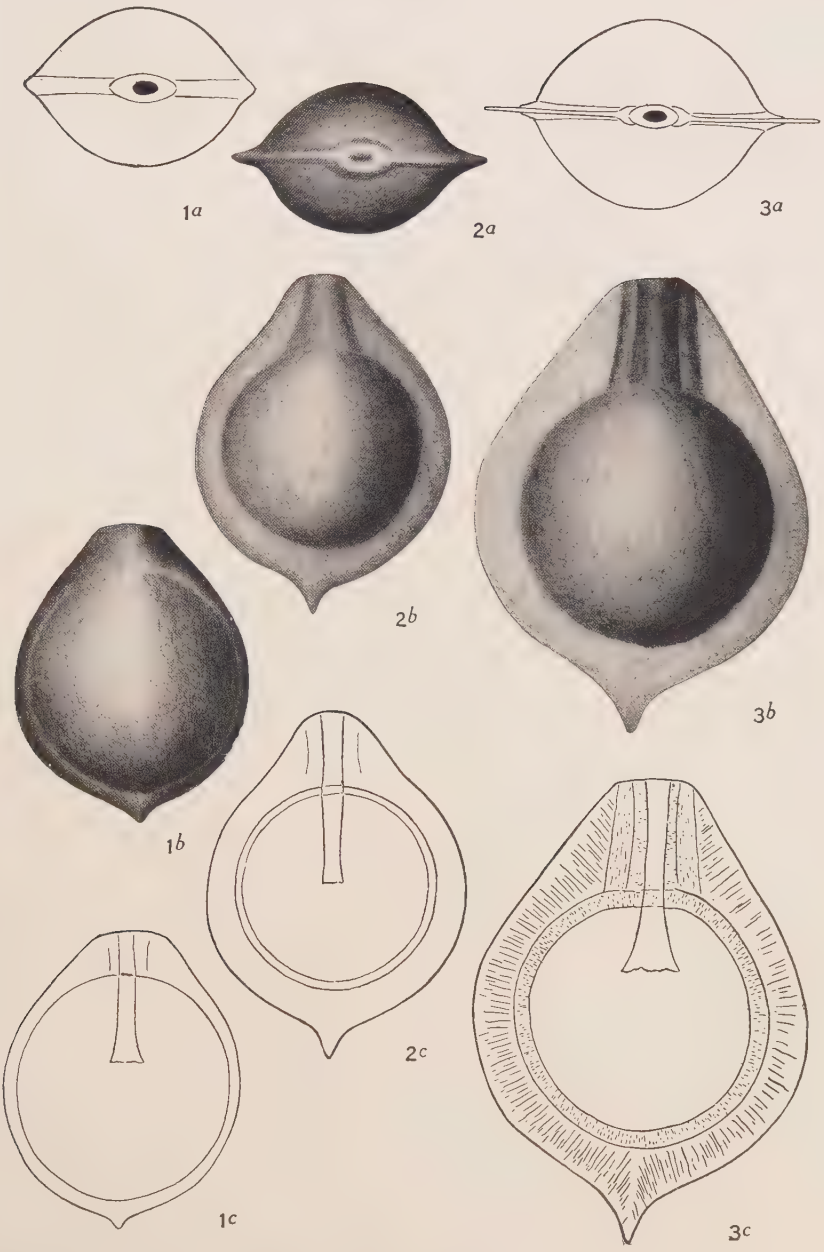


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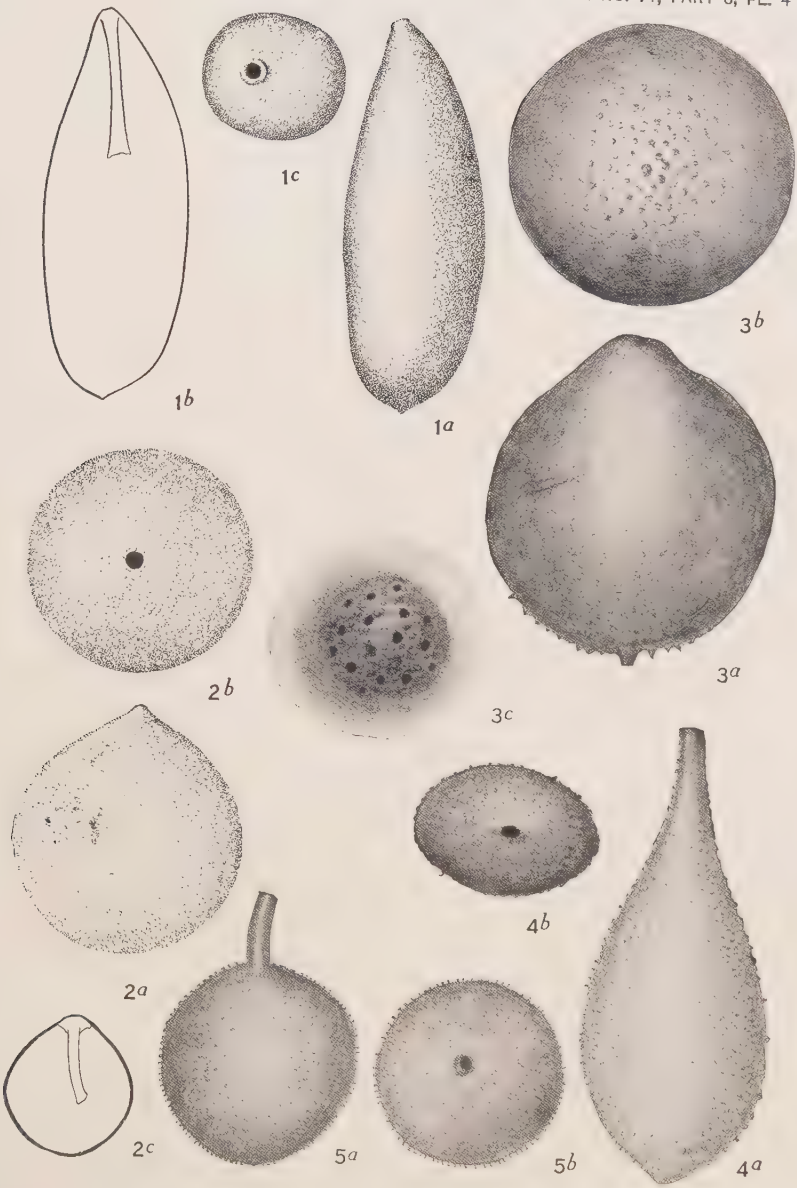


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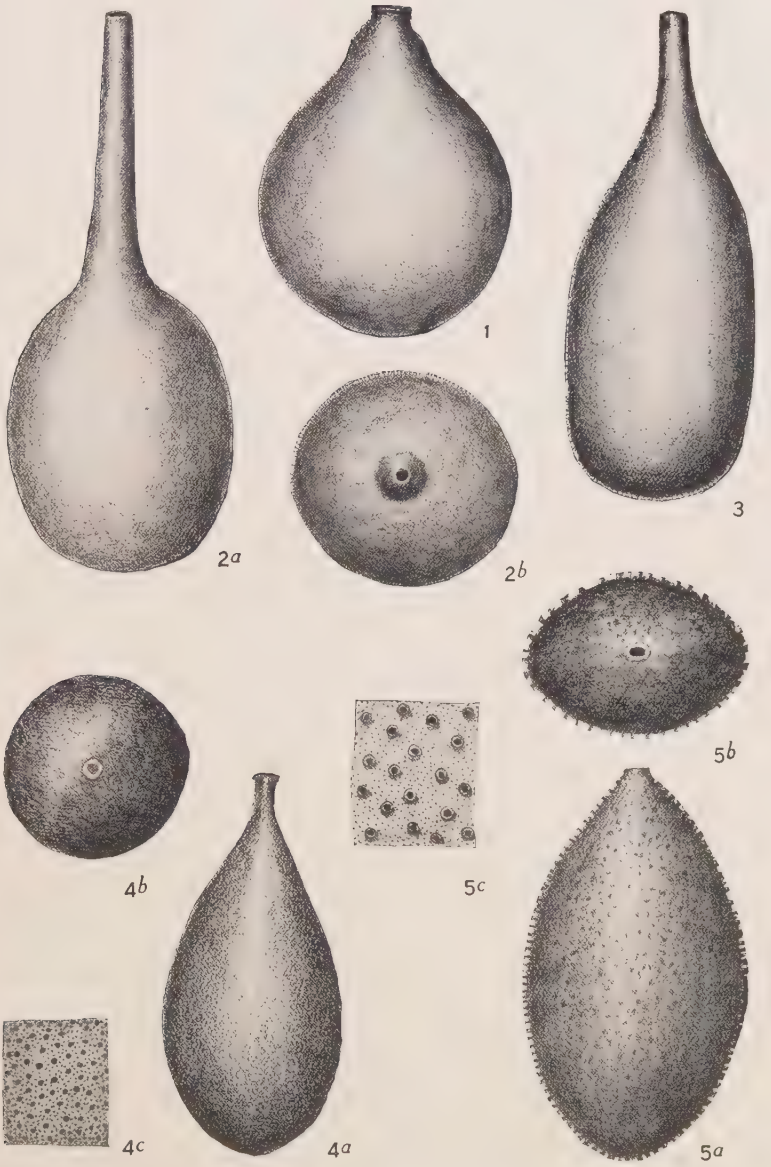


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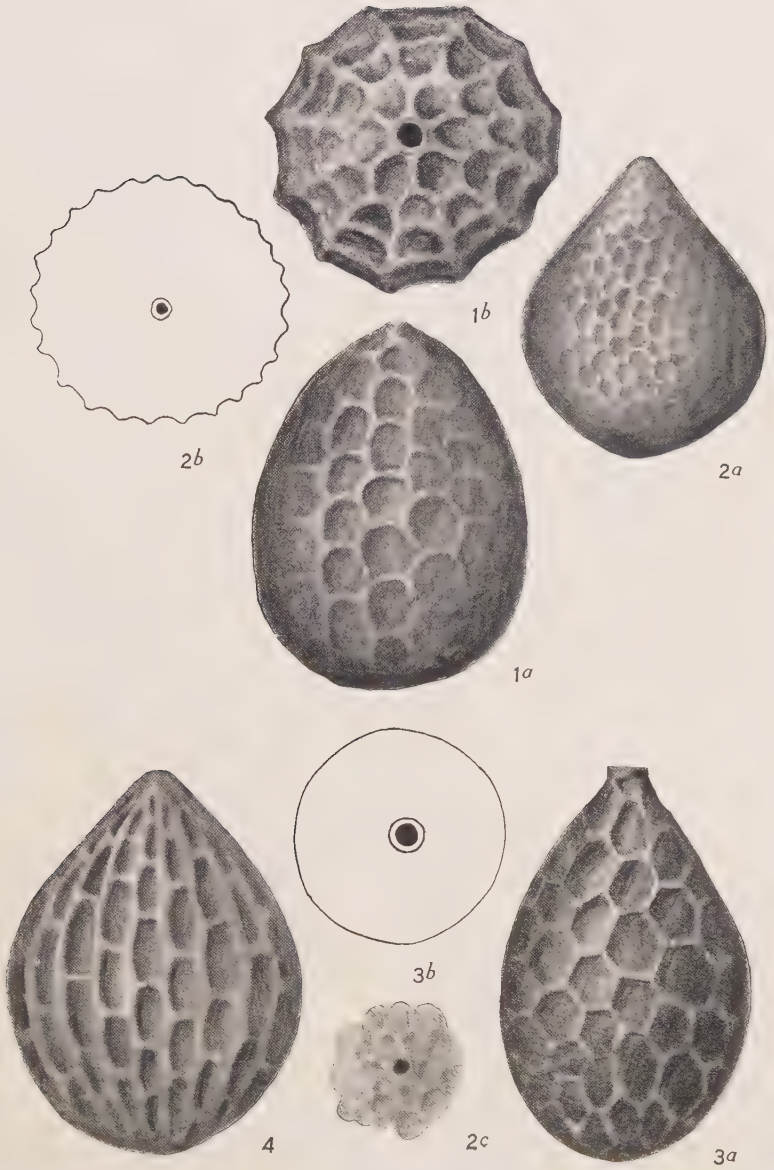


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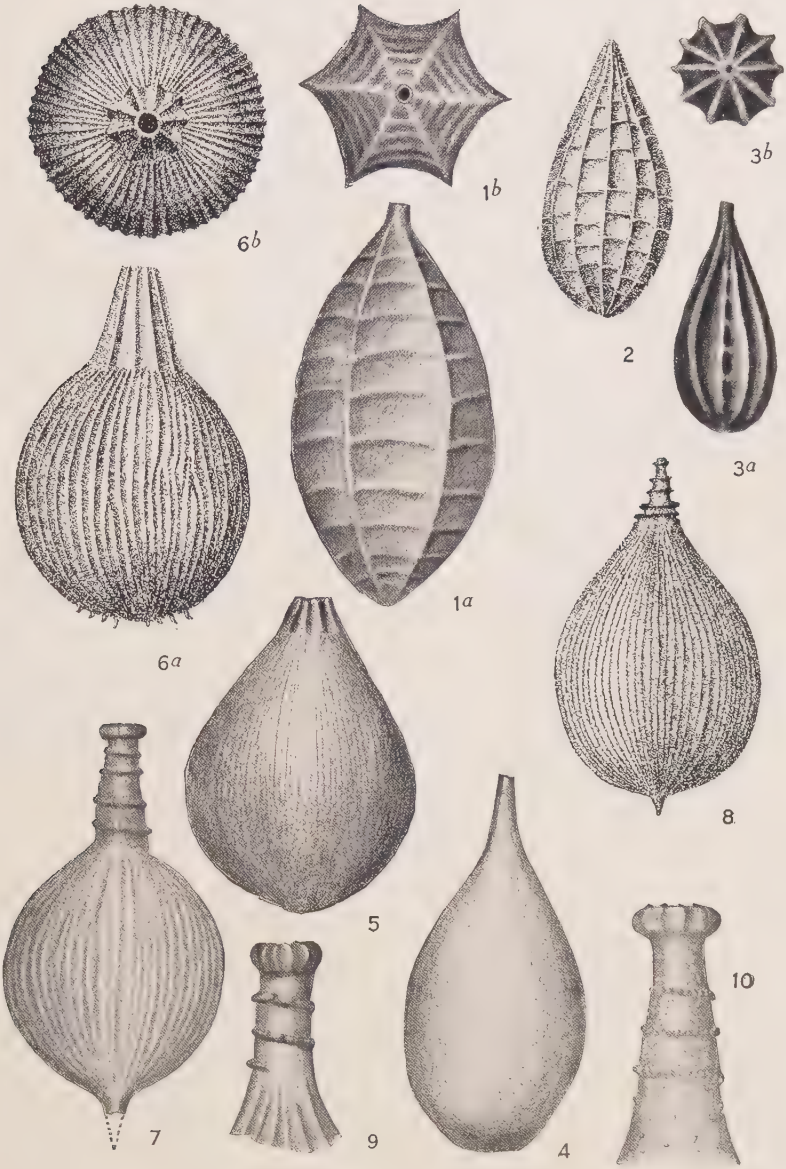


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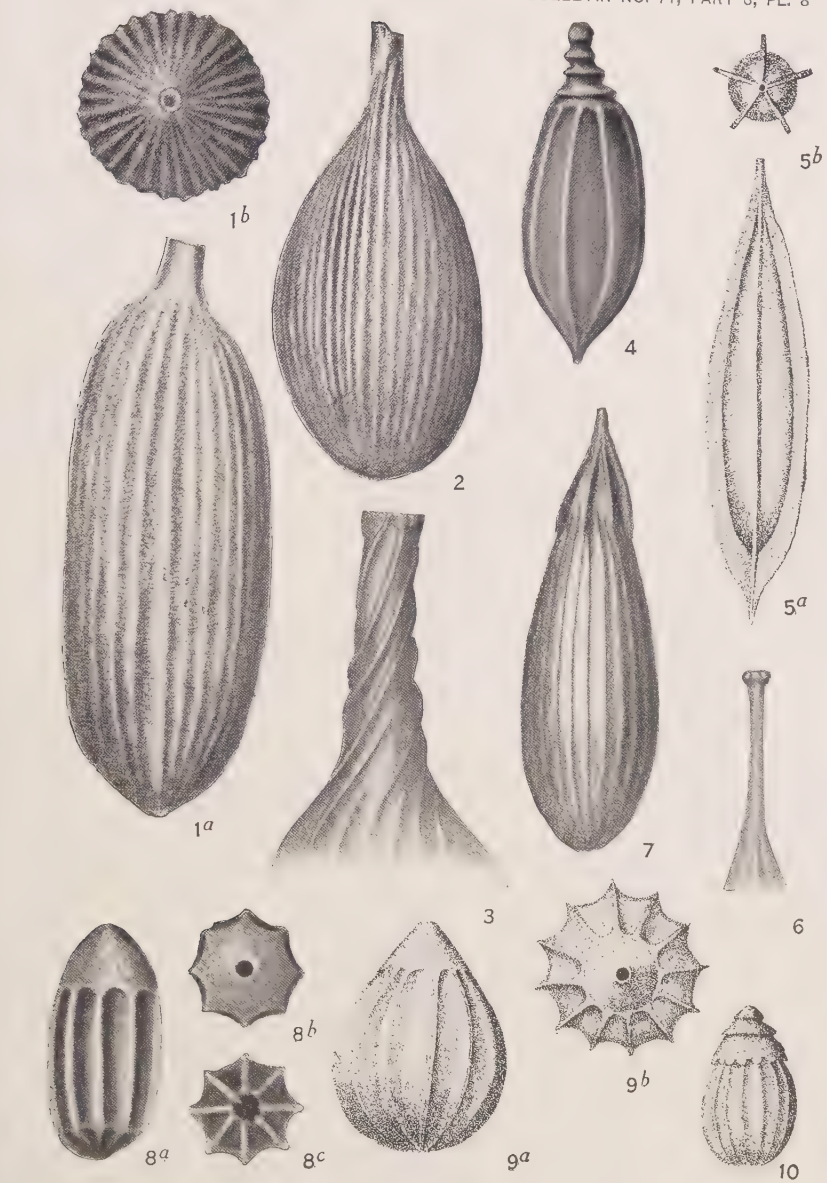


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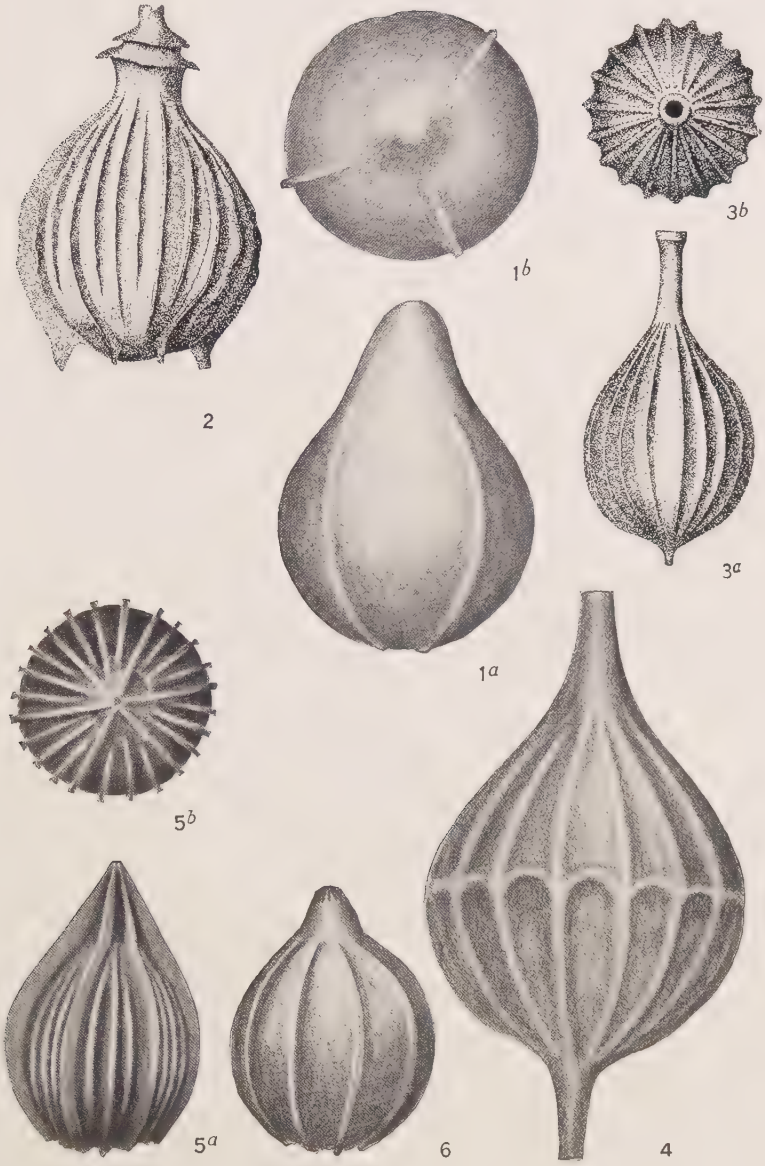


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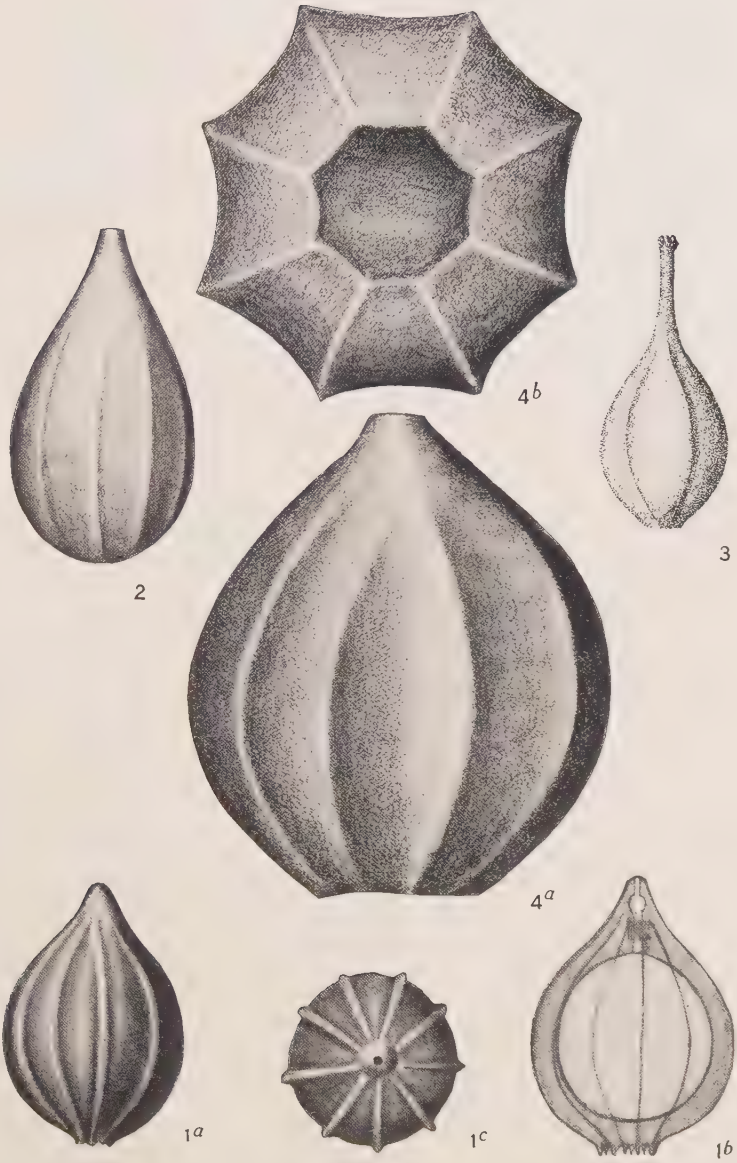


LAGENIDÆ OF NORTH PACIFIC OCEAN.

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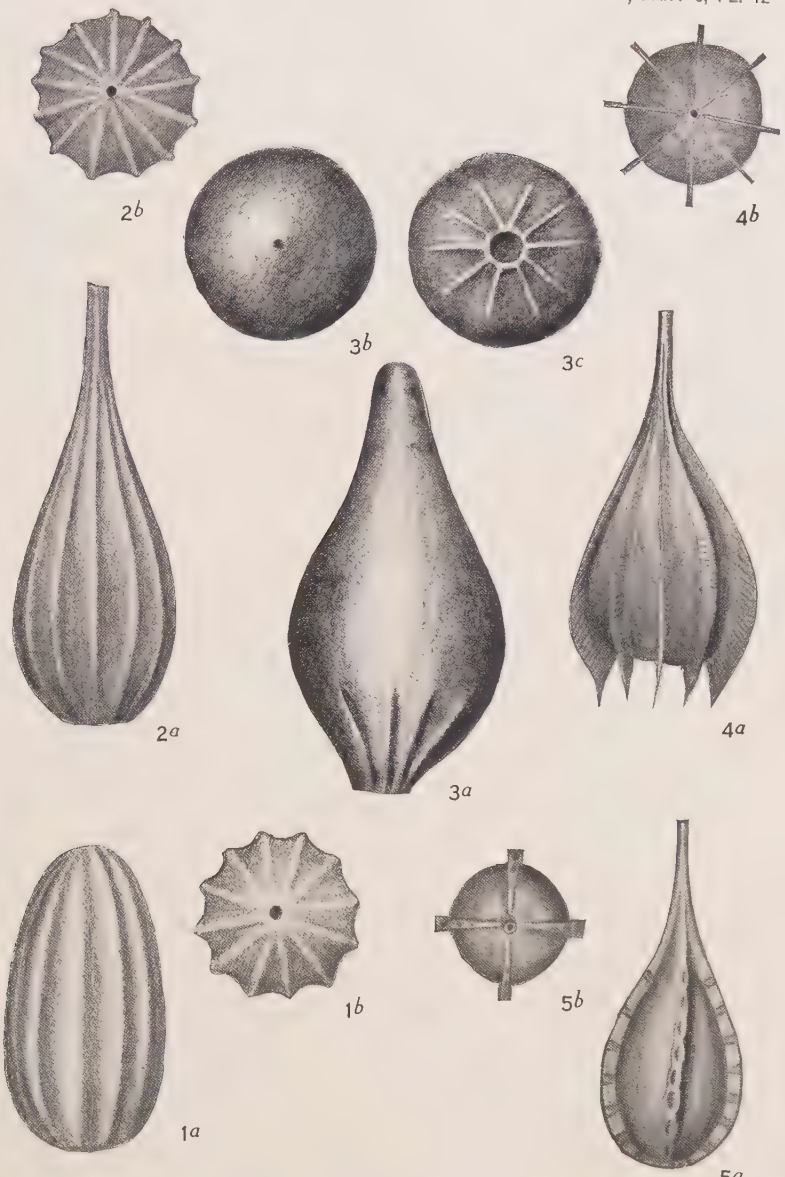


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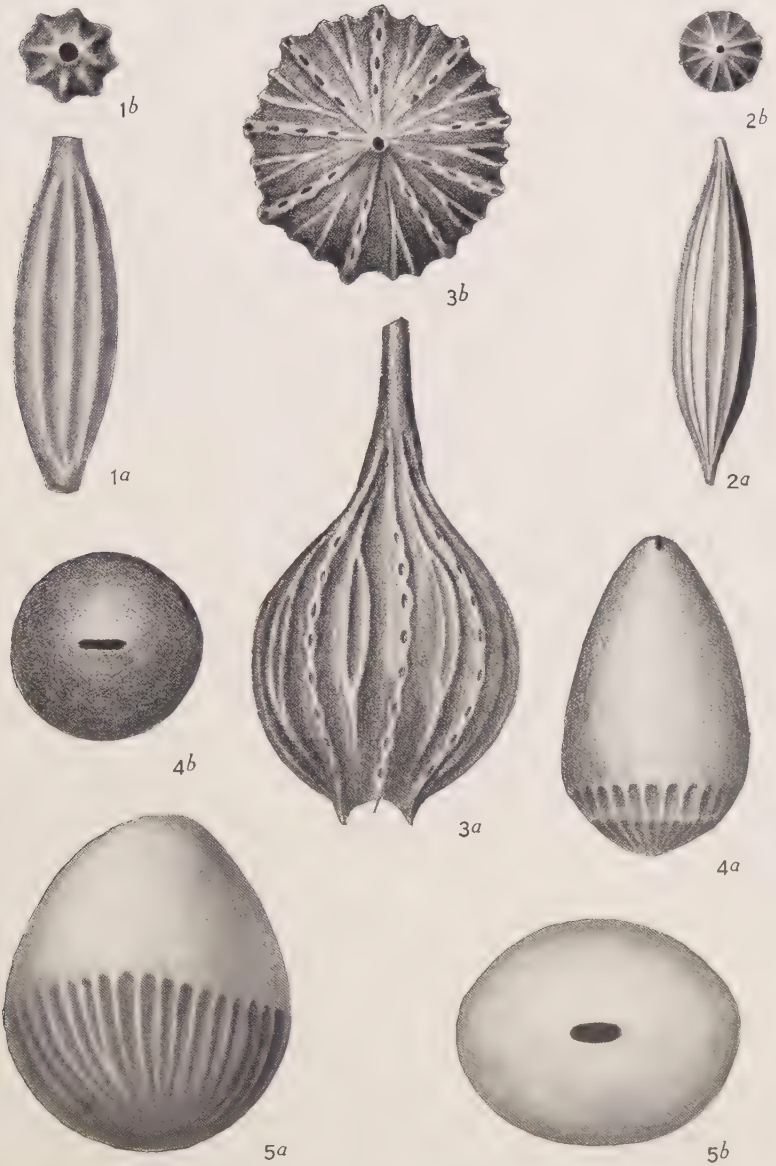


LAGENIDÆ OF NORTH PACIFIC OCEAN.

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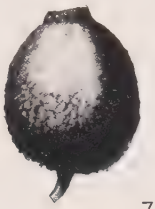
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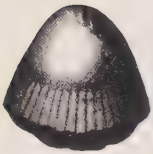
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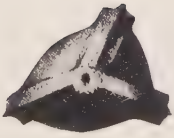
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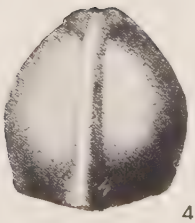
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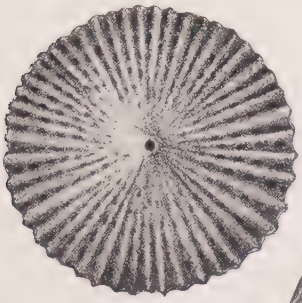

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3*a*

1*a*

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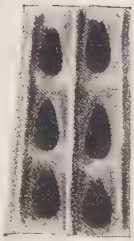

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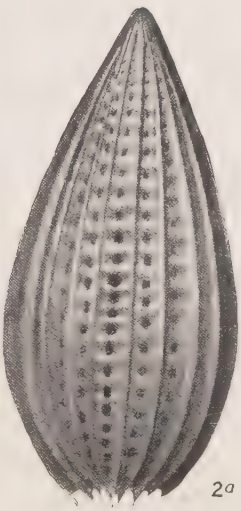

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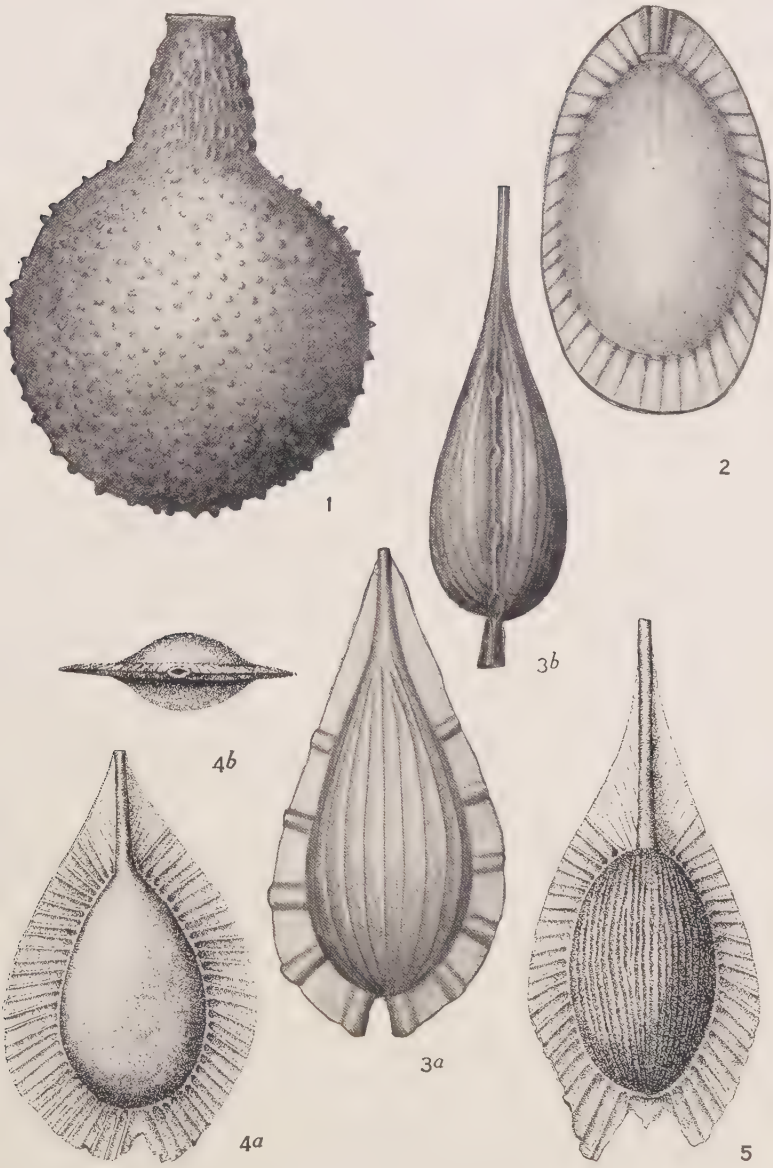


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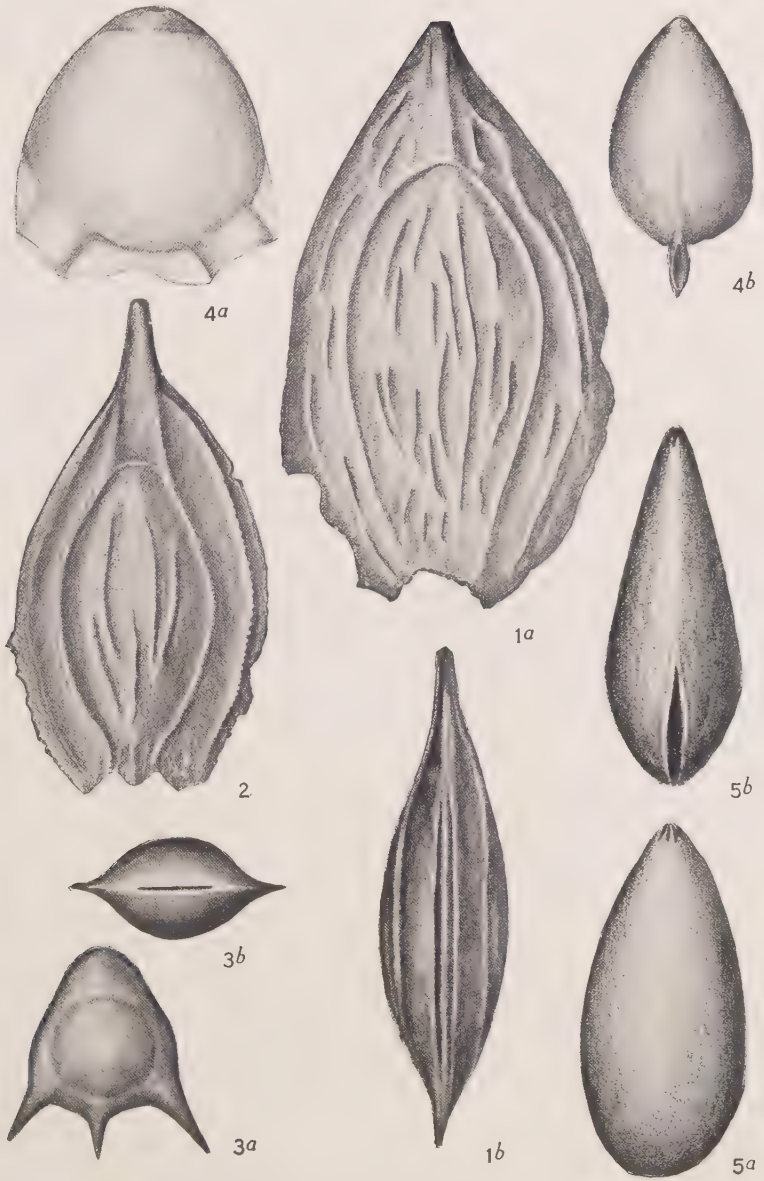


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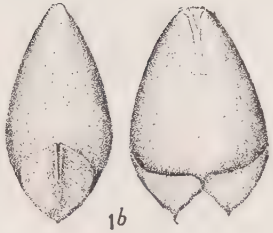

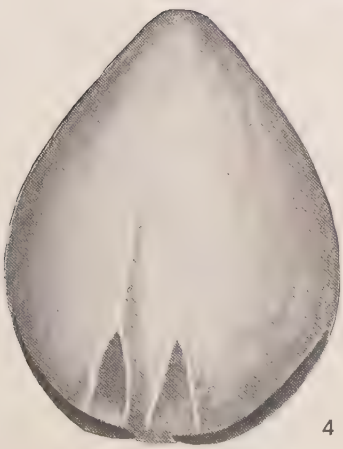

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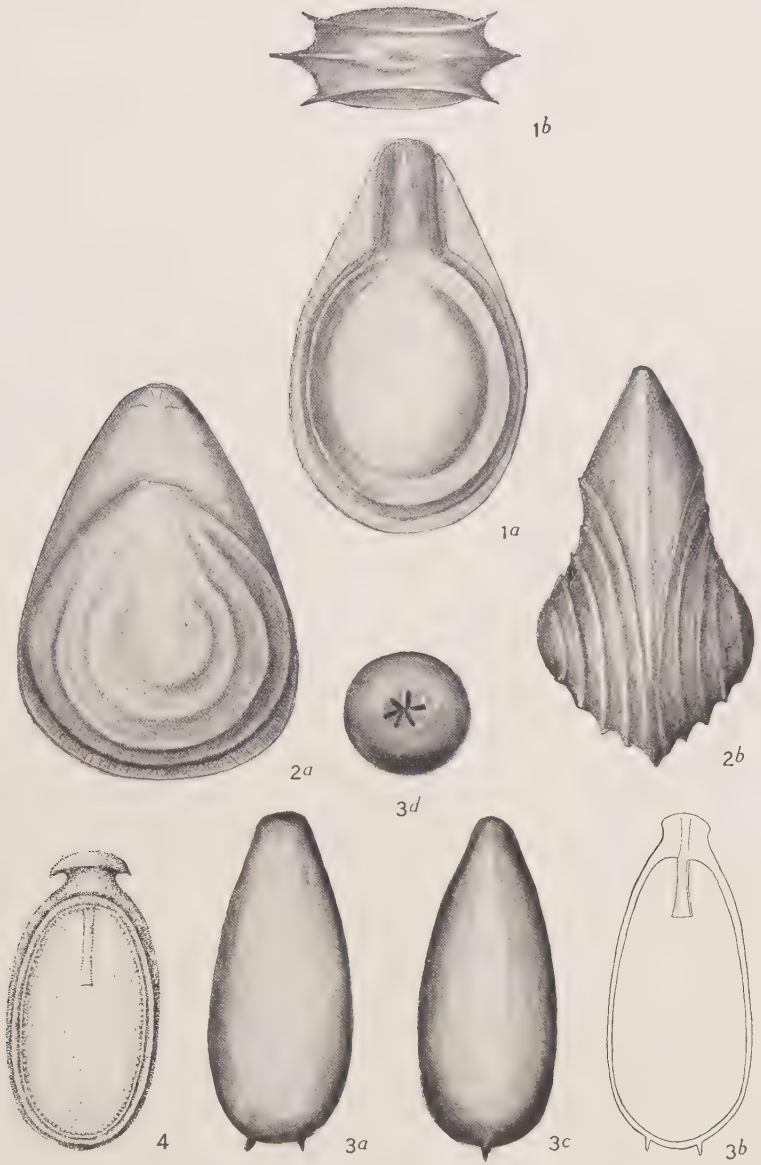


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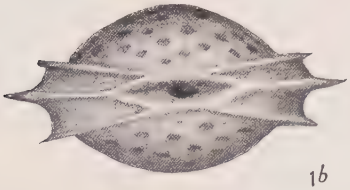

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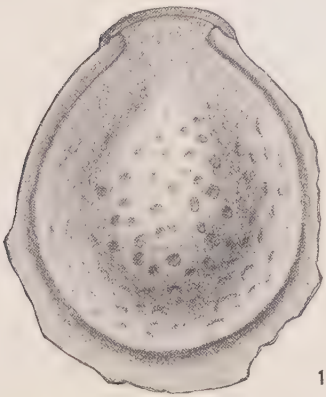

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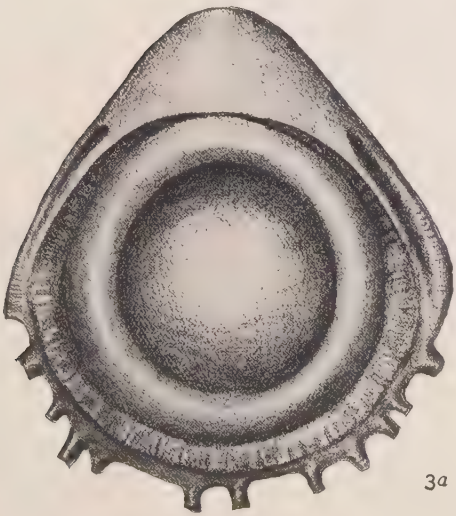

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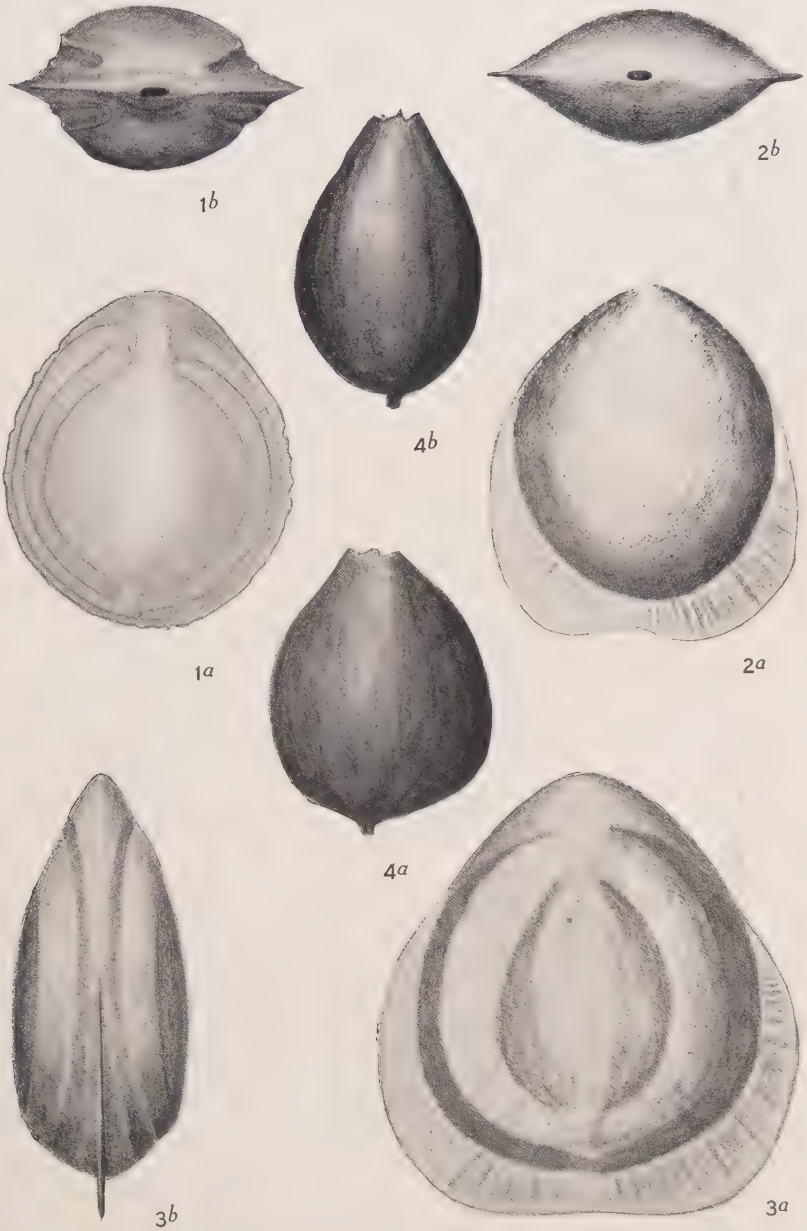


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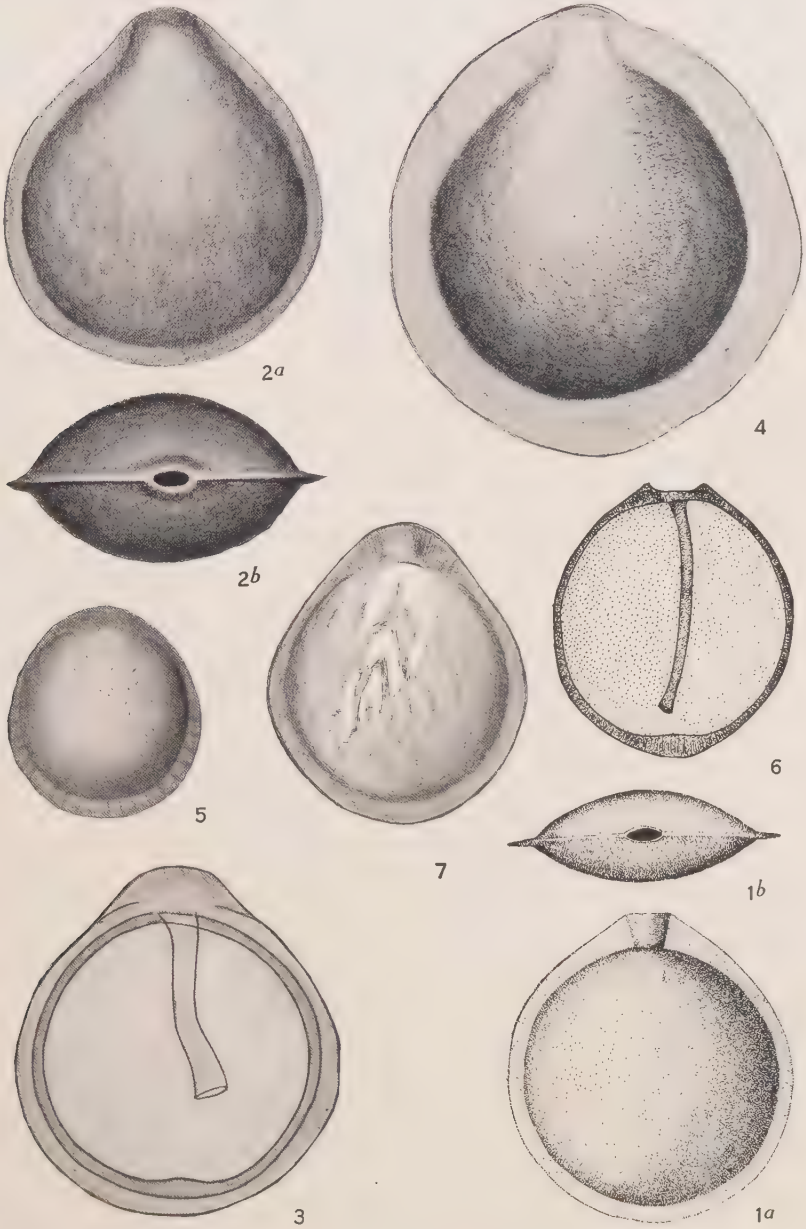


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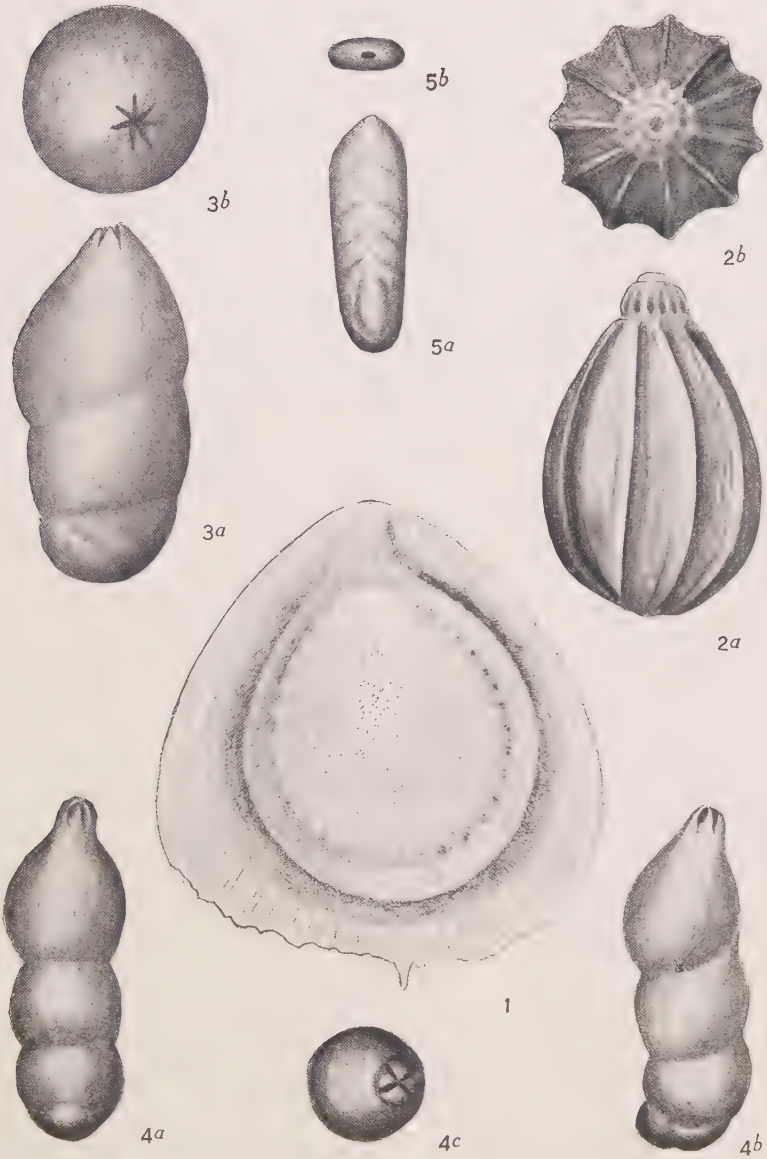


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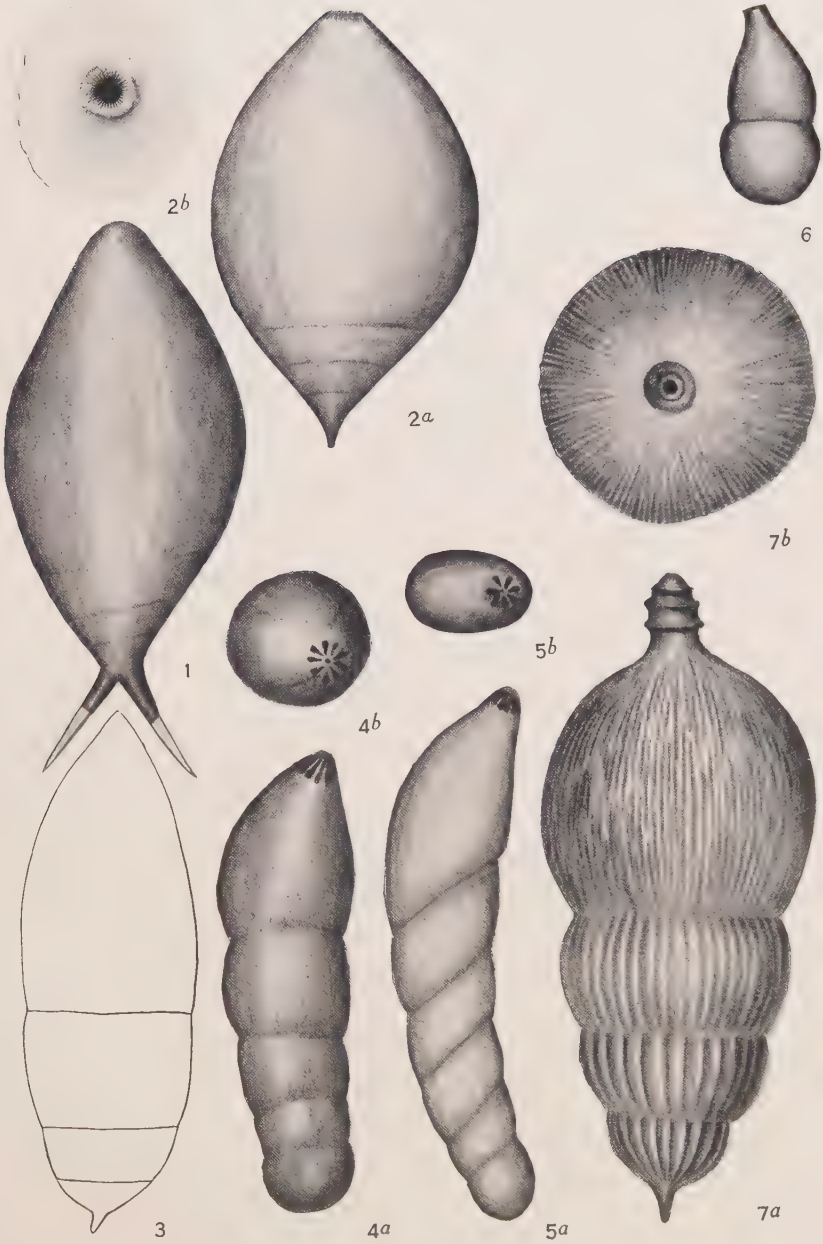


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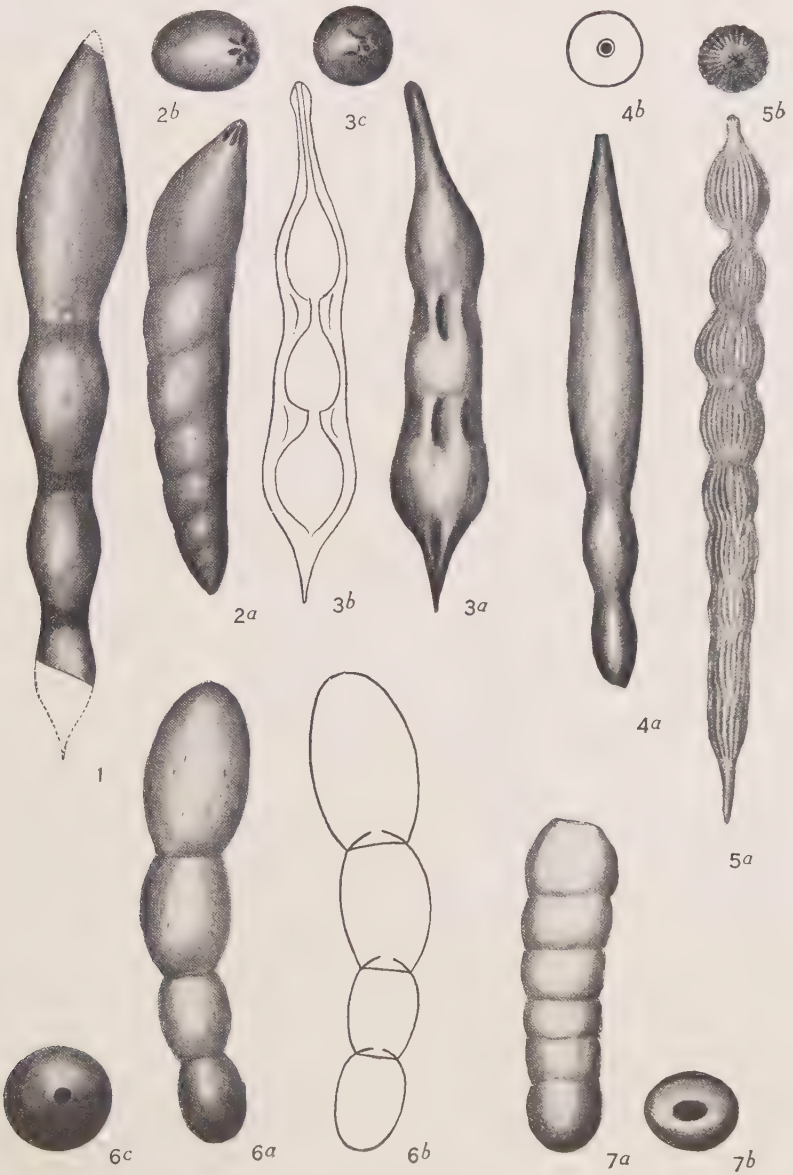


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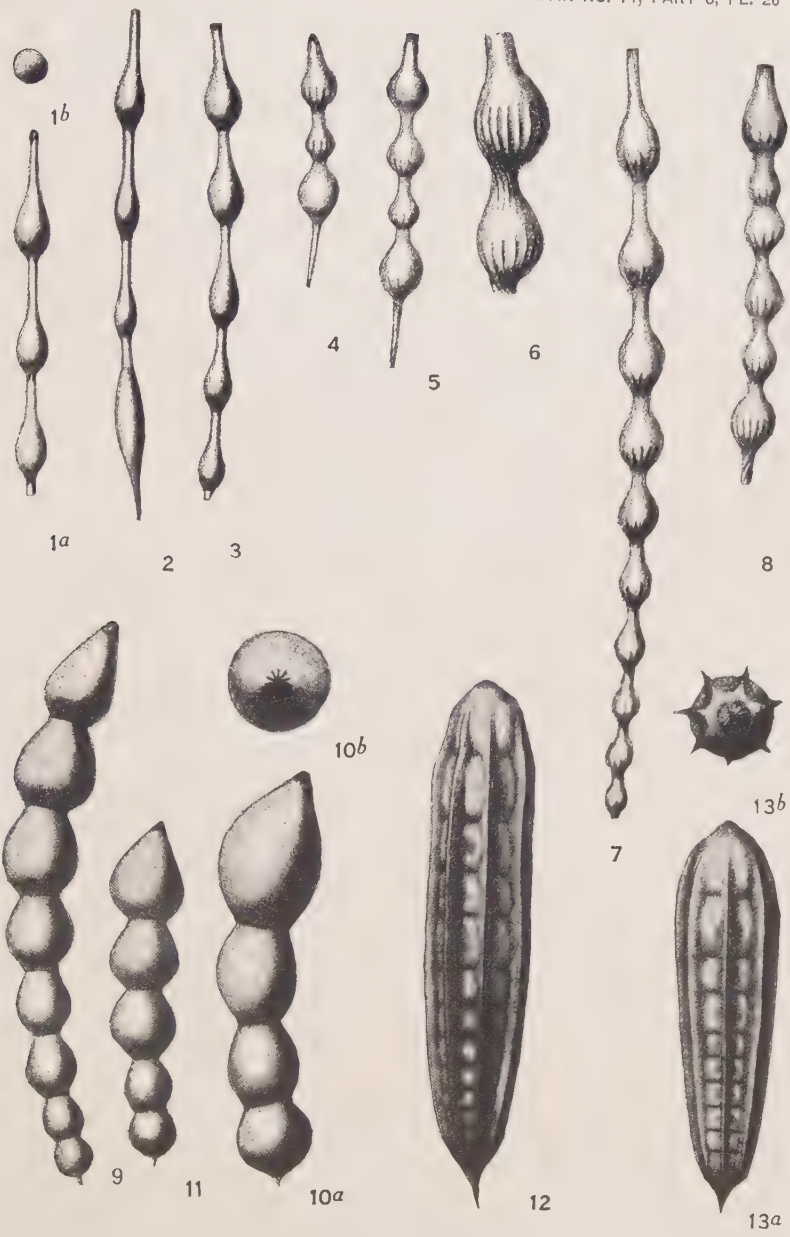


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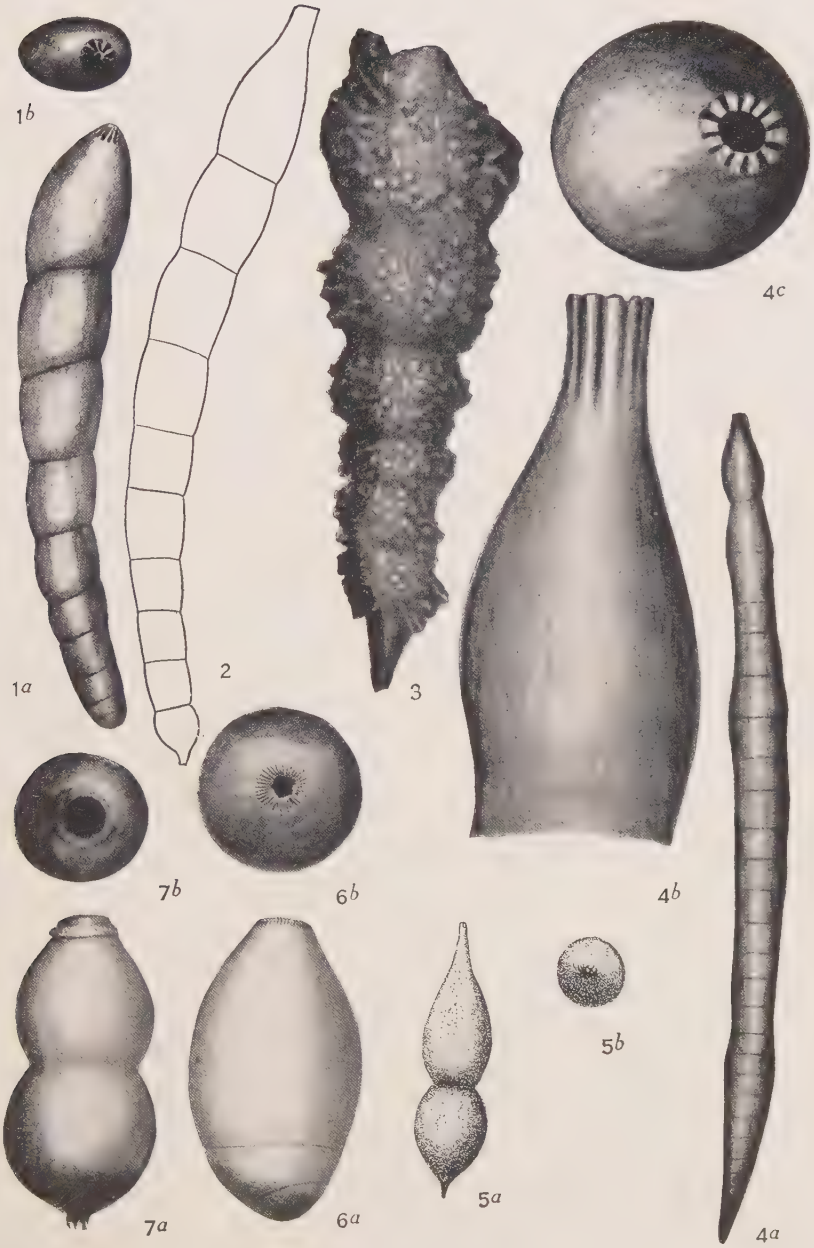


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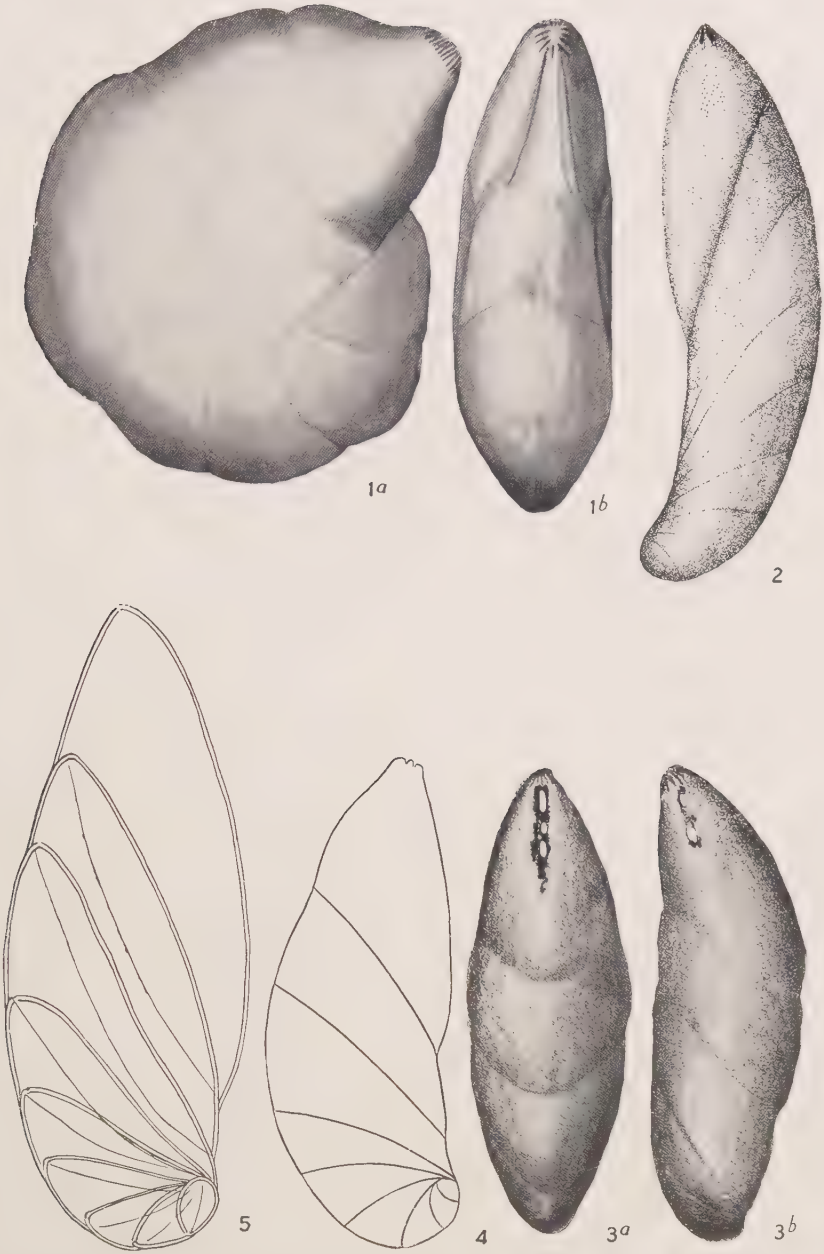


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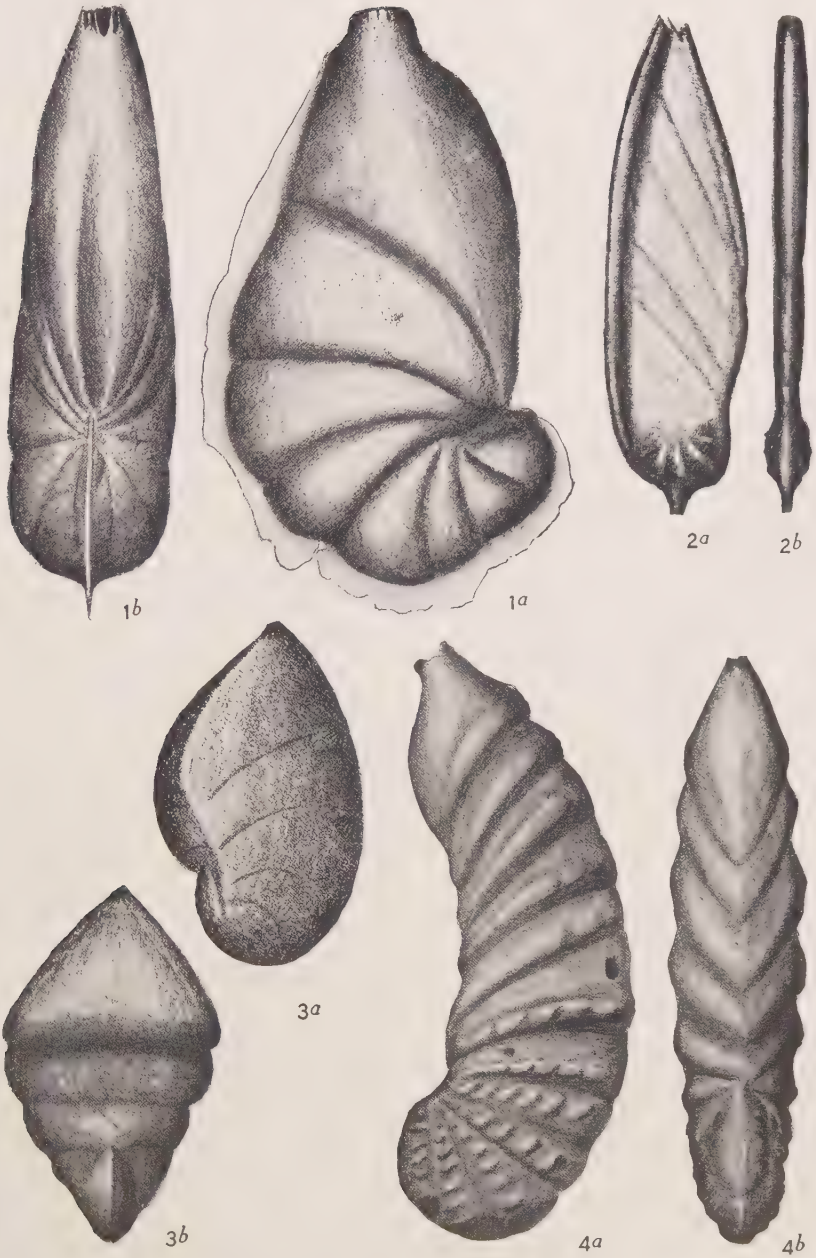


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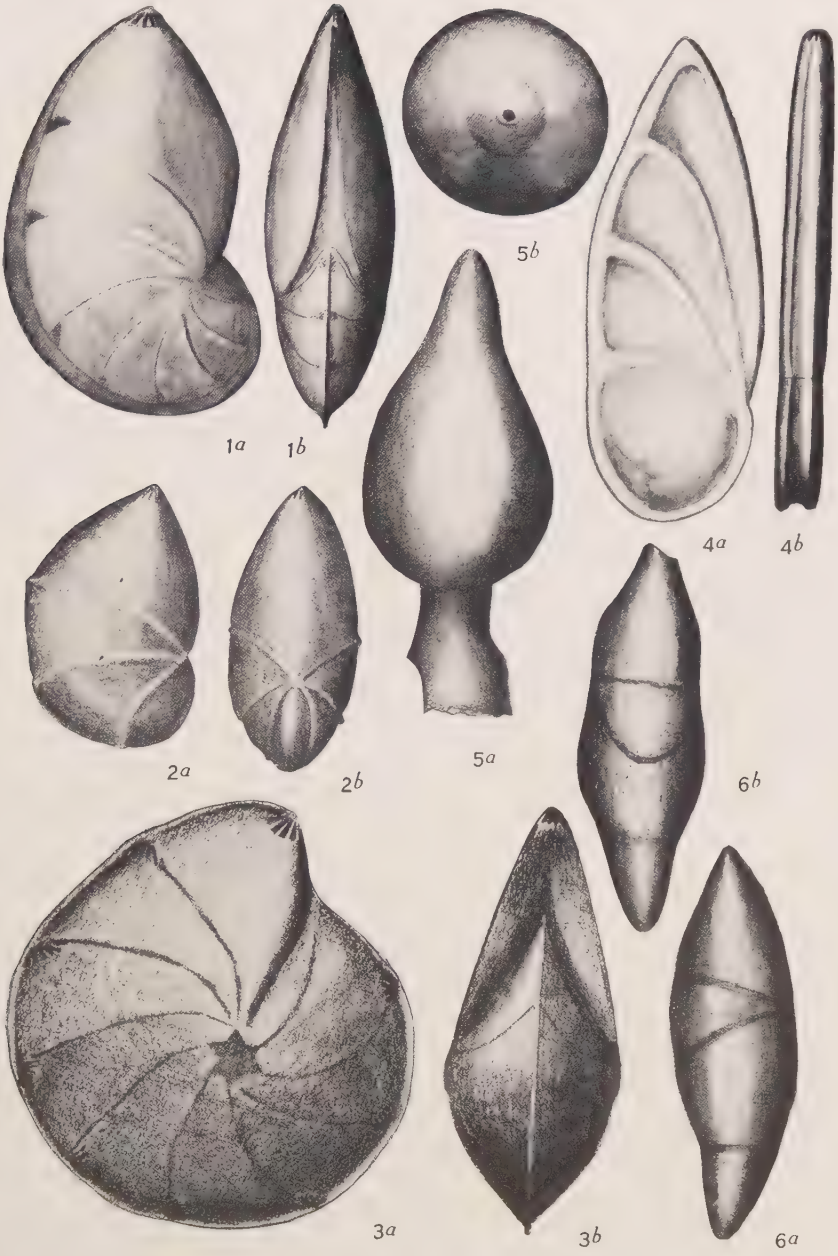


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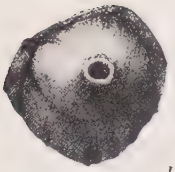
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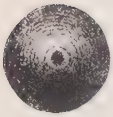
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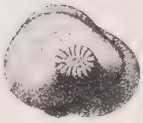
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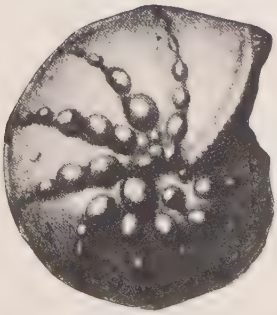
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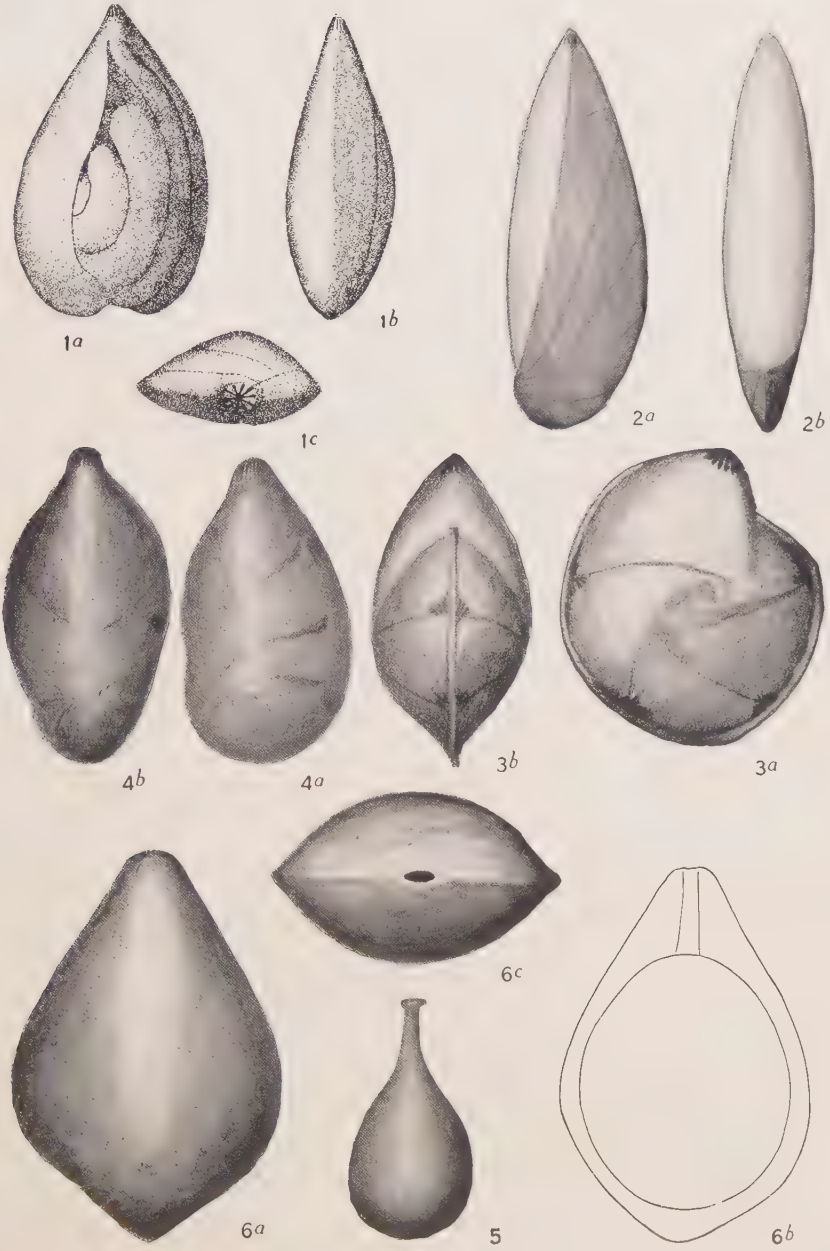


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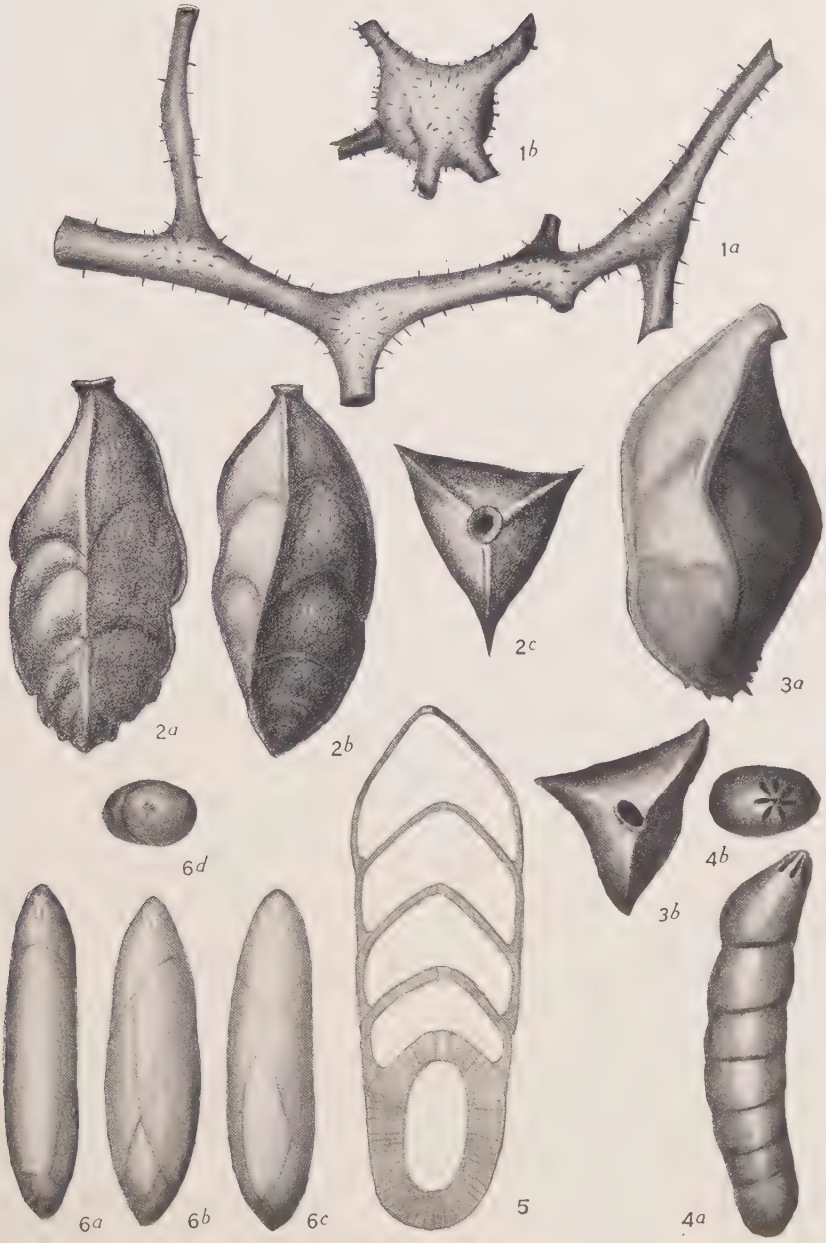


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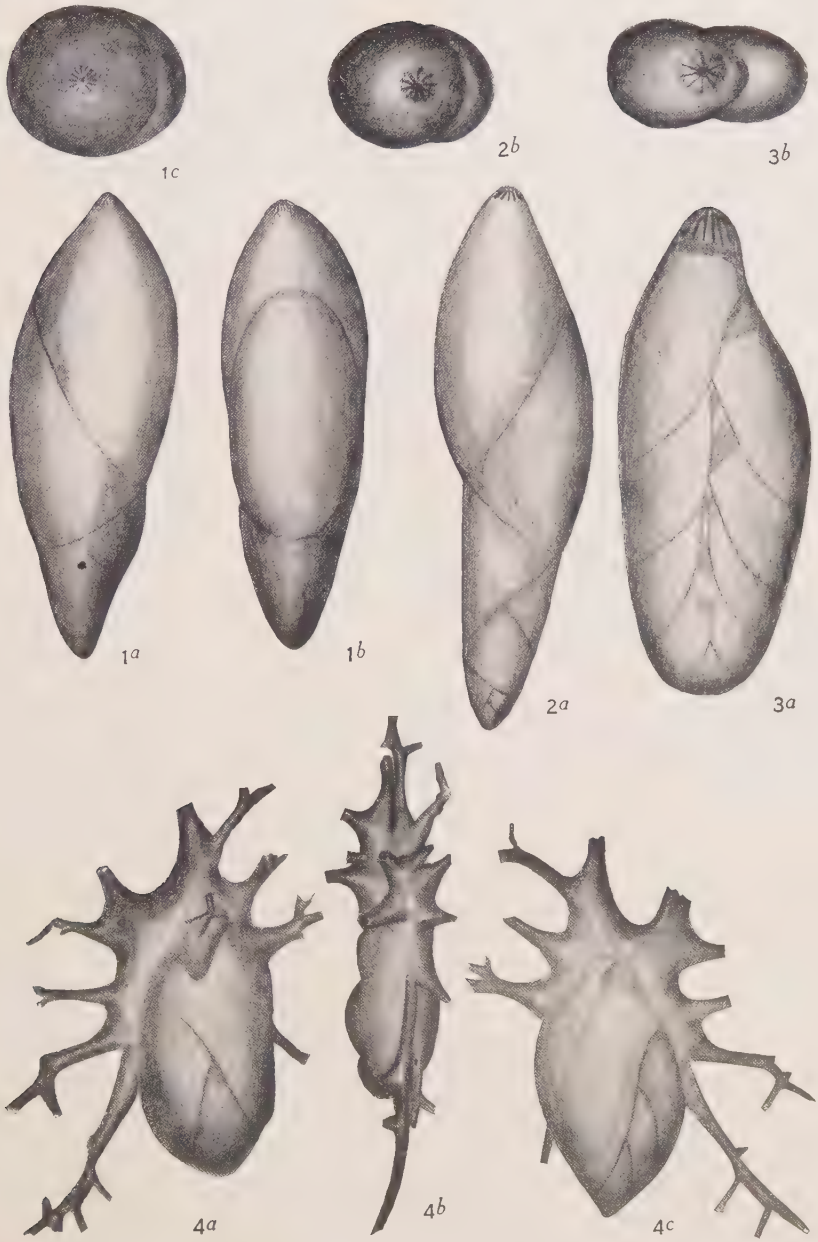


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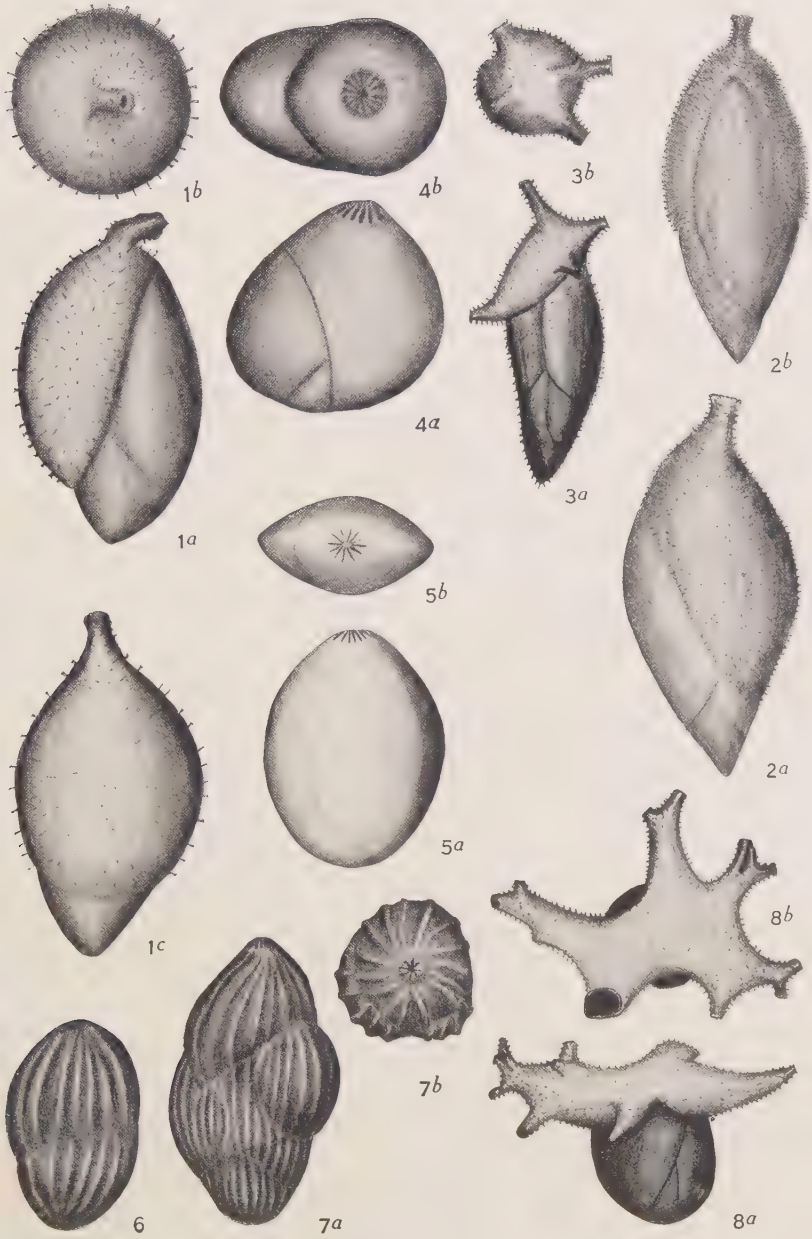


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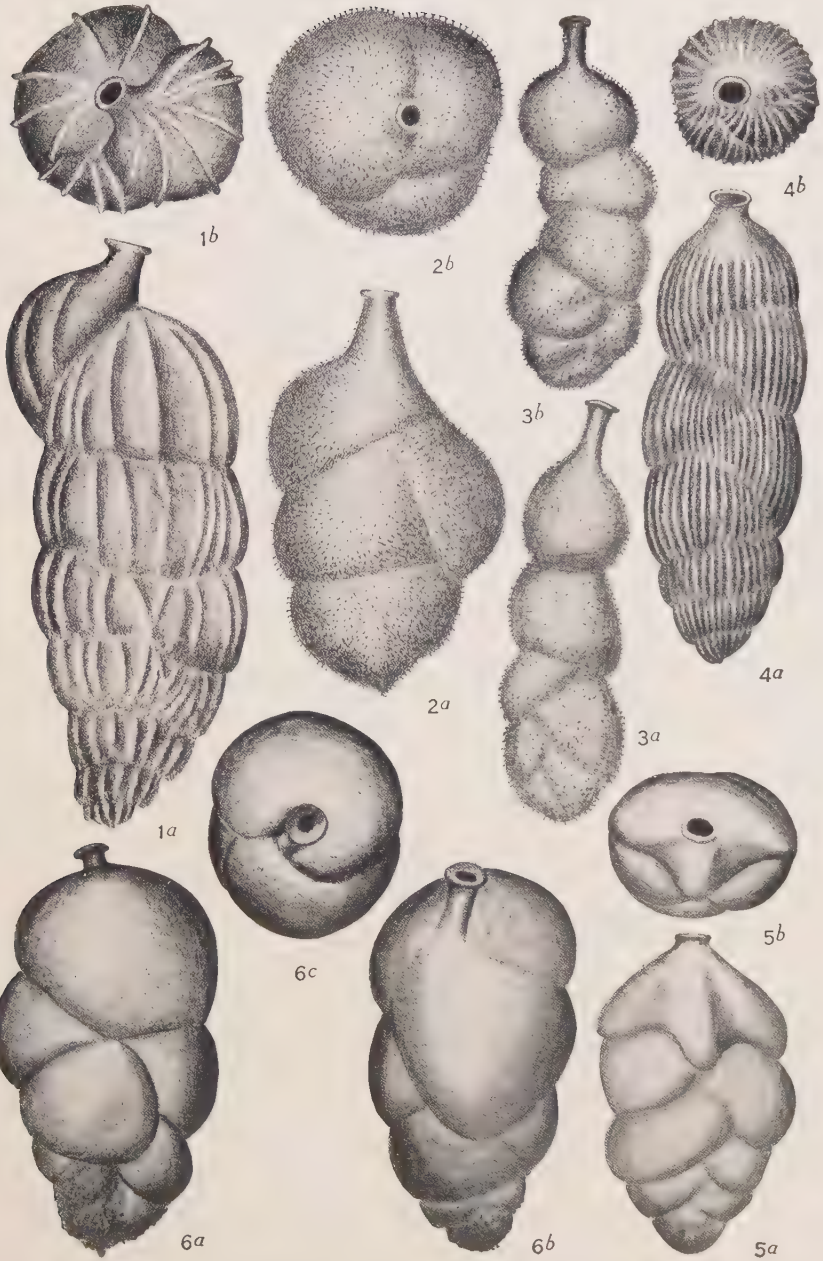


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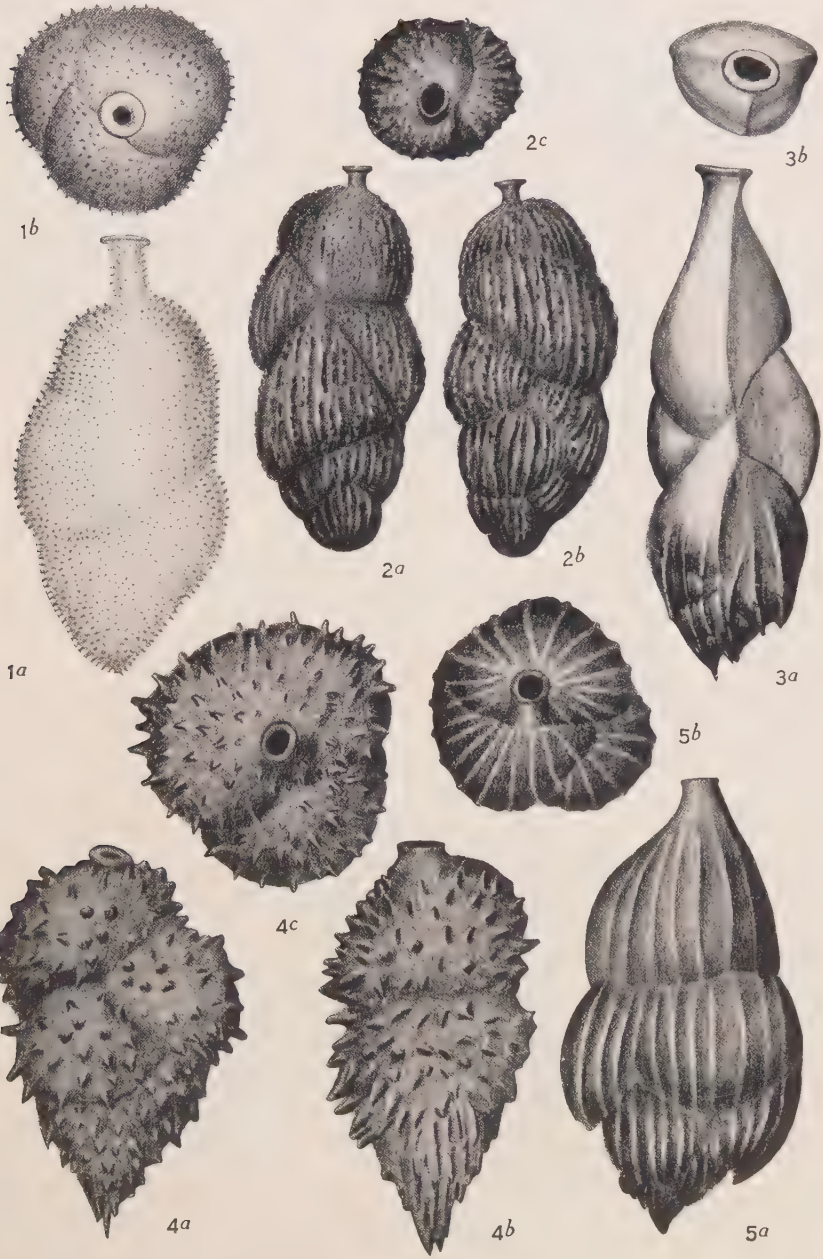


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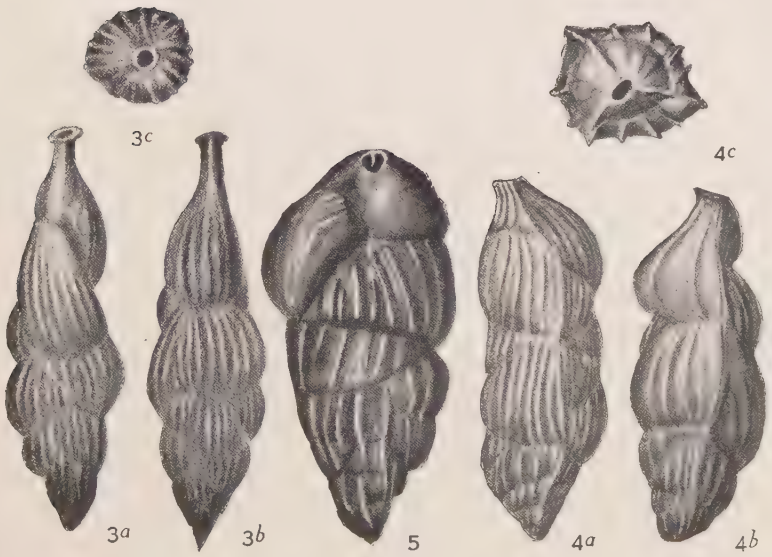


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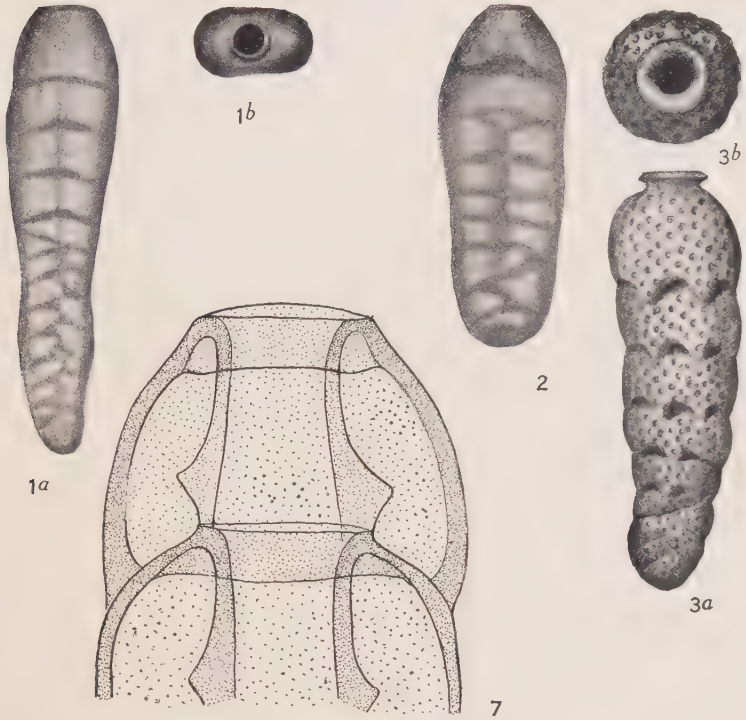


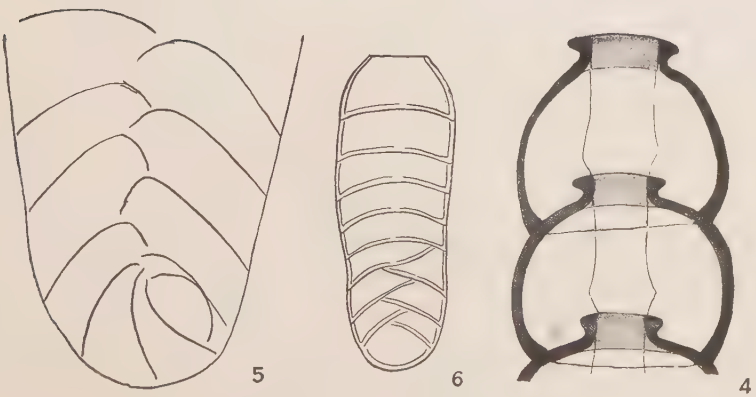


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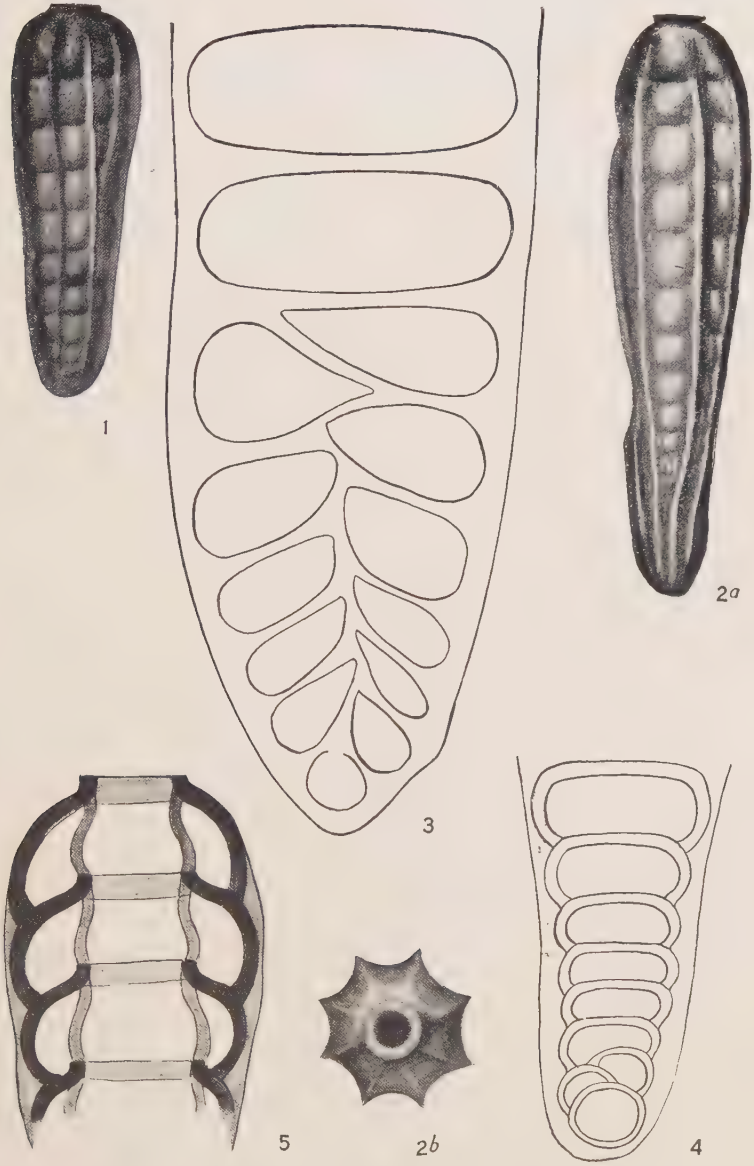


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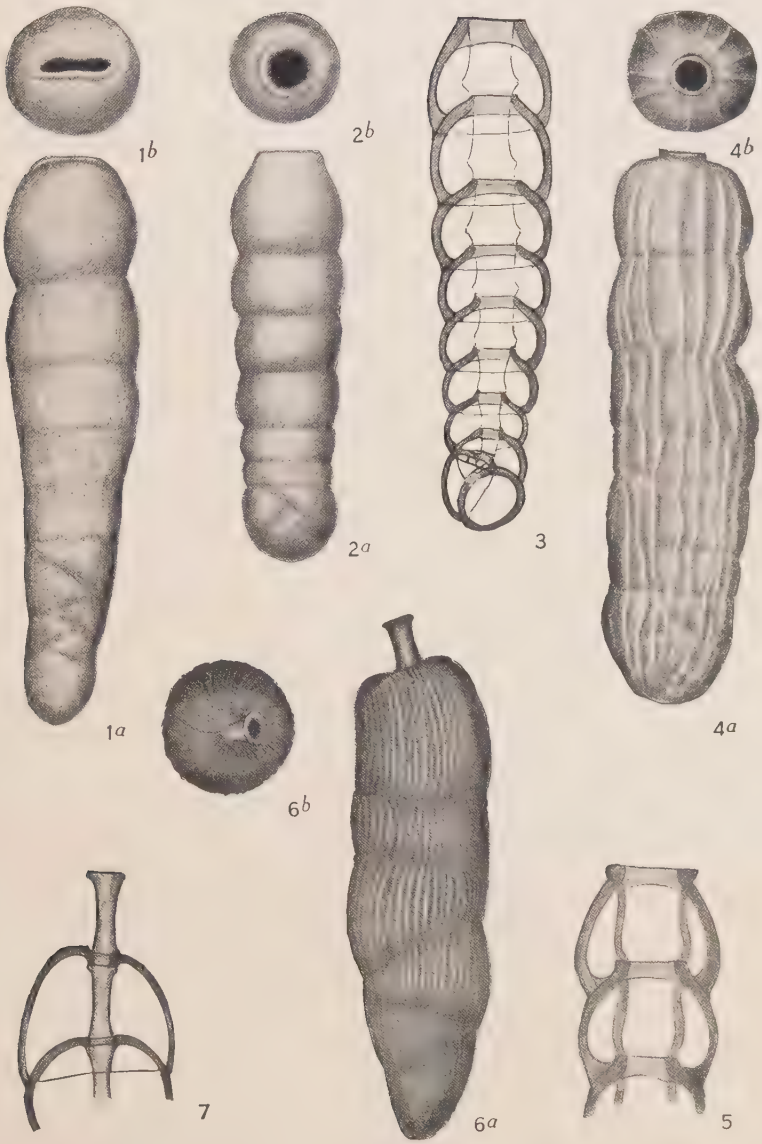


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